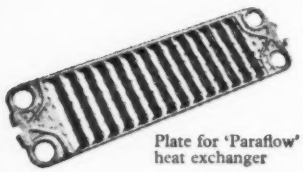
20 NOVEMBER 1959

METAL INDUSTRY

THE JOURNAL OF NON-FERROUS METALS



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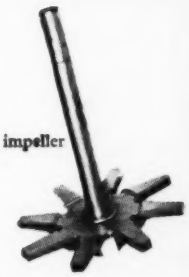

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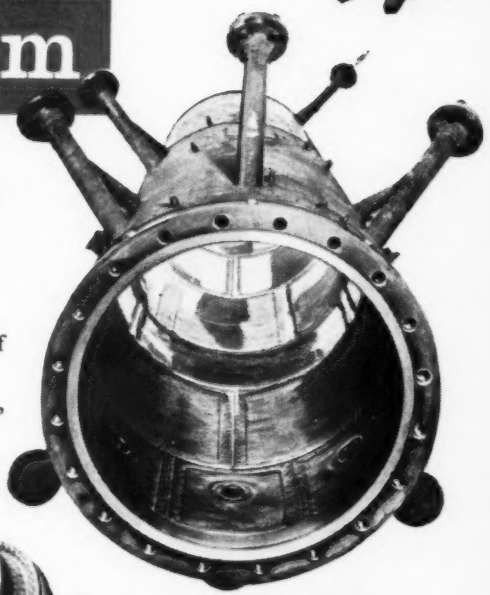

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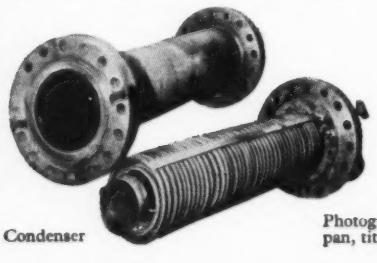

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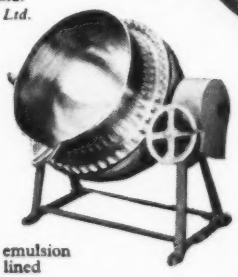

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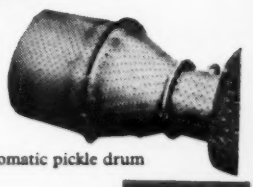

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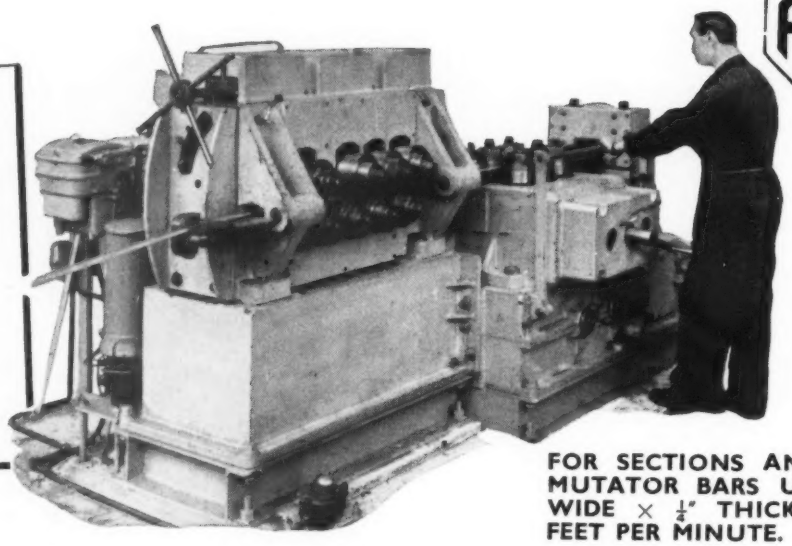

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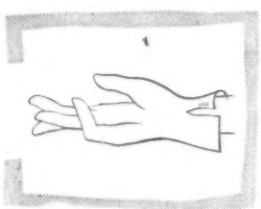

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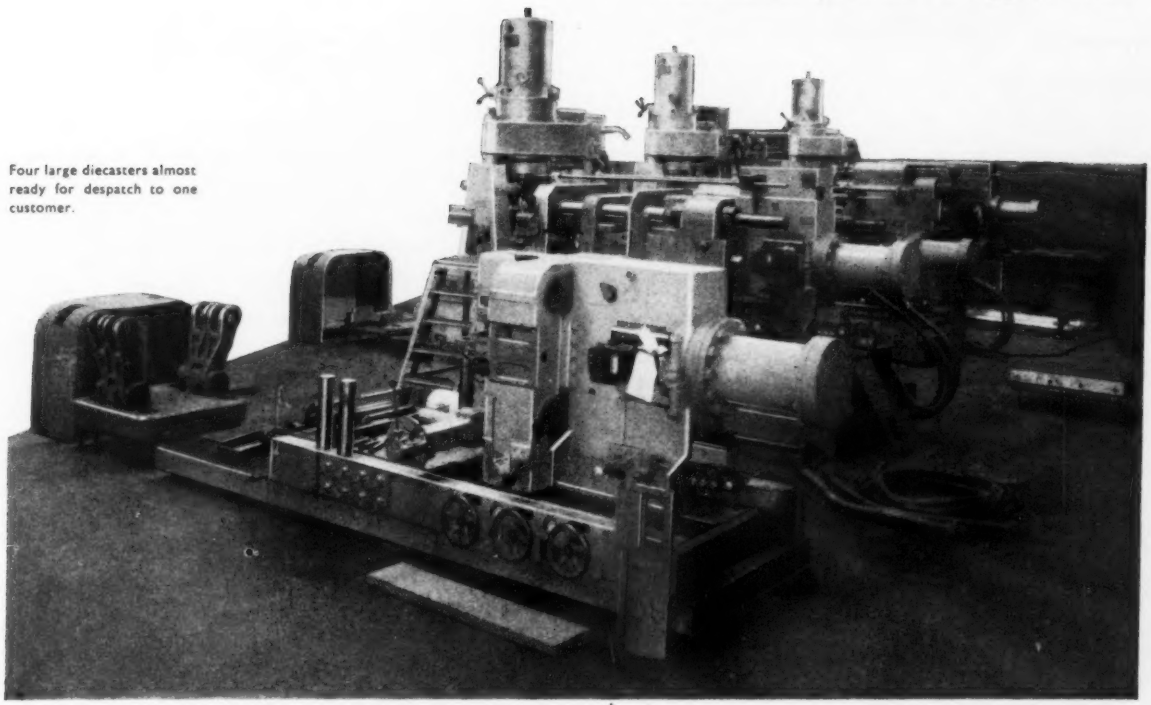

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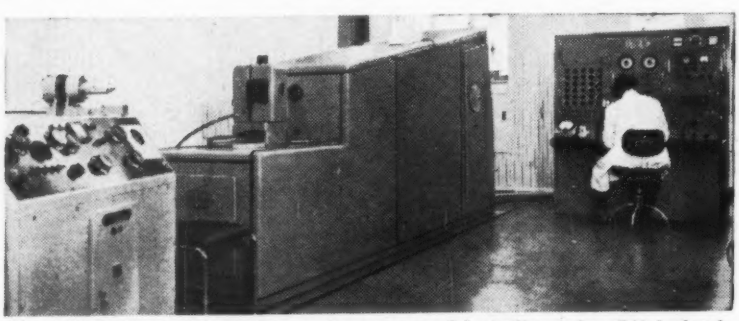

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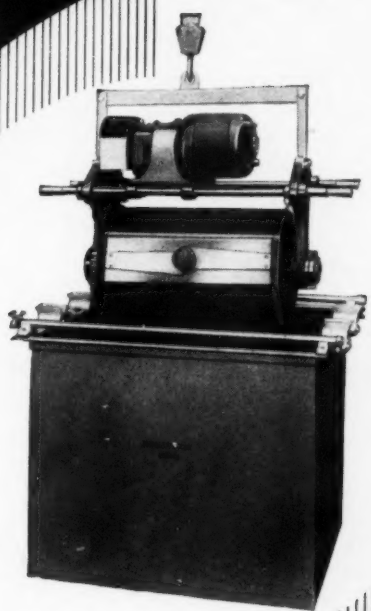

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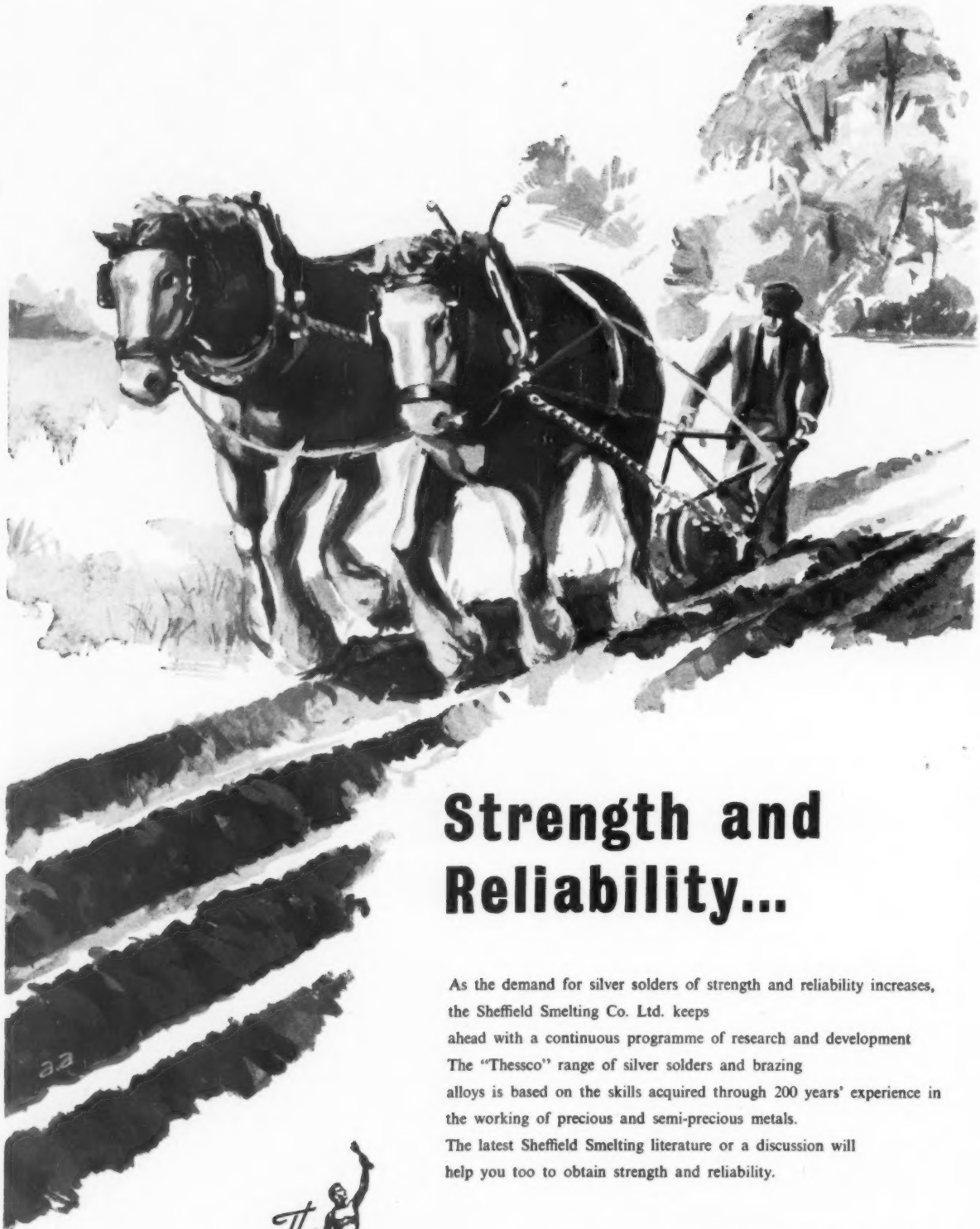

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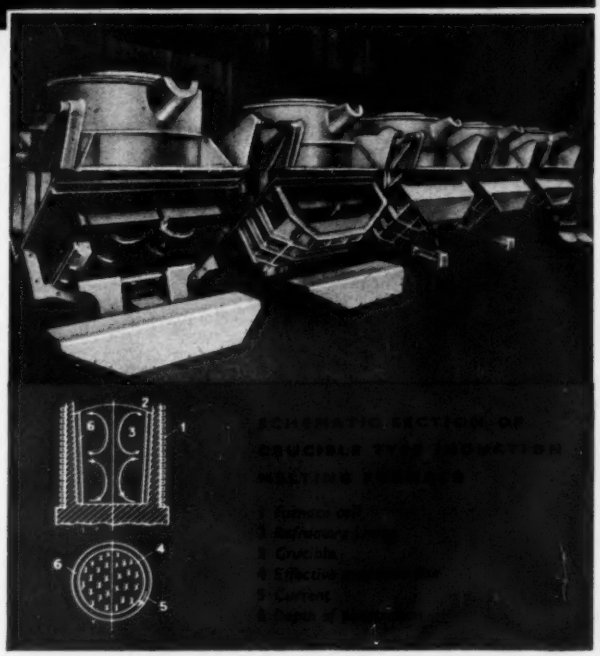

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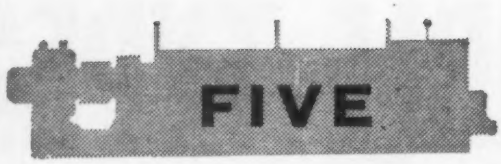

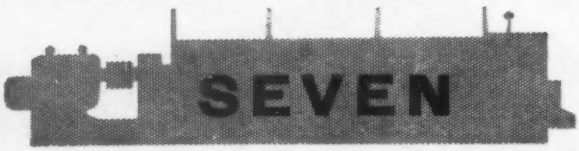

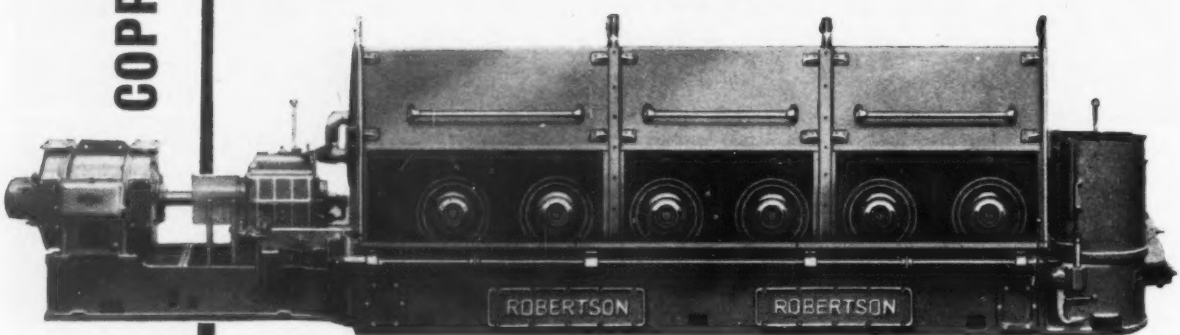

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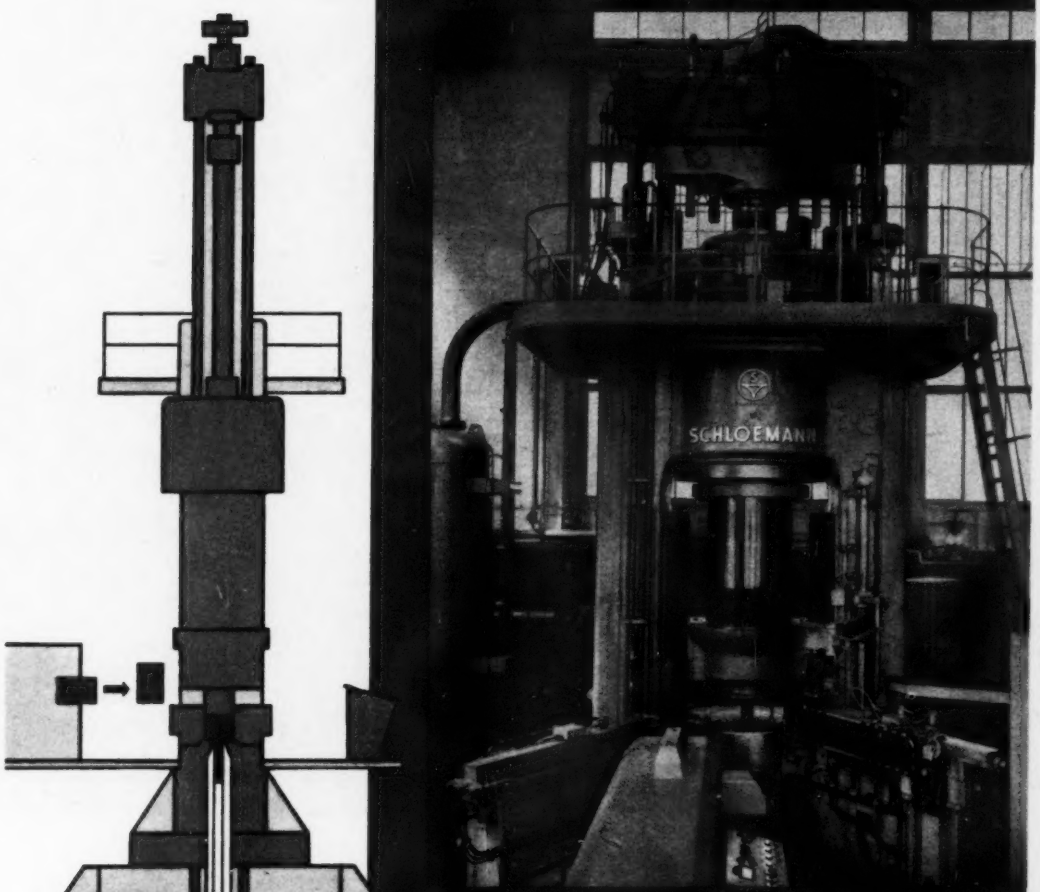

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METAL INDUSTRY

FOUNDED 1909

EDITOR: L. G. BERESFORD, B.Sc., F.I.M.

20 NOVEMBER 1959 VOLUME 95 NUMBER 15

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METAL INDUSTRY

VOLUME 95 NUMBER 15 20 NOVEMBER 1959

Quality Plate

AS a step towards improvement in quality of chromium plating and an answer to the all-too-numerous complaints about the lack of durability of many plated surfaces, the new British Standard B.S.1224:1959 is most welcome. It being recognized that no chromium plate can be satisfactory without an adequate underlay of nickel, the specification calls for a *minimum* nickel thickness on significant surfaces of 0·0012 in. on steel, 0·001 in. on zinc alloy and 0·0006 in. on brass where the articles are to be exposed to weather and corrosive atmospheres. For moderate conditions the corresponding thicknesses are 0·0008 in., 0·0006 in., and 0·0003 in., while for mild service 0·0004 in. is specified for steel and 0·0003 in. on zinc alloy. In all grades the minimum thickness of chromium is required to be 0·00001 in. The specification permits the use of copper as an undercoat to nickel provided the appropriate nickel thickness is applied. In the case of heavy duty deposits on steel, however, a minimum of 0·0003 in. of copper followed by a minimum of 0·001 in. of nickel may be applied.

New, more stringent laboratory tests also form part of the Standard. Corrosion resistance, for instance, is tested by exposure of the plated surface to moist sulphur dioxide, the time of exposure ranging from 6 to 24 hours. Another similar test uses a mist of sodium chloride/acetic acid solution. The specification recognizes only the metallographic method of thickness testing, but for day-to-day control purposes it recommends the use of the thermo-electric plating gauge developed by the British Non-Ferrous Metals Research Association, with which nickel thicknesses can be measured with an accuracy of ±0·0001 in. as rapidly as one reading every 5 seconds. As within the terms of the Standard a manufacturer can now specify that for all grades the nickel deposit shall exhibit a minimum ductility, a test for that property is described in which a plated test strip is bent over a mandrel, the radius of which is related to the thickness of the strip to give a minimum elongation in the deposit. While it is not possible to specify an entirely satisfactory test for adhesion, a number of ways in which this may be checked are suggested.

But, while it is a comparatively simple matter for the large user of plated goods, such as, for instance, the automobile manufacturer, to specify and check that they conform to the Standard, it is not so easy for the ultimate buyer to differentiate between good and bad chromium plated finishes. It is, therefore, even more to be welcomed that identification of products complying with the Standard will be made possible by the adoption of a labelling scheme which, in the first instance, is being operated by The Mond Nickel Co. Ltd. The labels—red for "severe", blue for "normal", or green for "mild" service—will be supplied at cost to platers and manufacturers of plated products on condition that the labels are applied only to plating which complies with B.S.1224. This fact is made clear on the labels themselves which, incidentally, vary in size and presentation to suit the variety of goods and their packaging, so that the man-in-the-street can see at a glance what he is buying.

At this stage it will be left to platers and manufacturers to satisfy themselves that their finishes are in accordance with the Standard, and the success of the scheme will depend on their co-operation. One matter for regret, though in the circumstances it could hardly be expected, is that no provision is made in the scheme for the regular checking of articles carrying the labels as, for example, would be necessary before a "kite mark" could be incorporated. It is hoped, however, that ultimately an independent, non-commercial organization who could undertake such a task will be formed by those who believe in good workmanship.

Out of the MELTING POT

Also of Interest

OVER twenty years ago, F. Sauerwald described the grain refining effect of zirconium in cast and wrought magnesium-base alloys. He also discovered, about the same time, the special effects produced by hydrogen in magnesium alloys containing zirconium. In the molten alloys, hydrogen has the effect of quantitatively eliminating the zirconium, which precipitates out in the form of insoluble zirconium hydride. In the case of the alloys in the solid state, he found that heat-treatment in a hydrogen atmosphere increased the elastic limit and the tensile strength. Several years' work was required to overcome the various difficulties that presented themselves in the course of the attempt to put to practical use the beneficial grain refining effects of zirconium additions to magnesium alloys. By contrast, the other observation of Sauerwald—on the effect of hydrogen on the properties of zirconium-containing magnesium alloys—has received hardly any attention until comparatively recently. The incentive behind a recently published investigation is readily deduced from the fact that the work was concerned essentially with the behaviour of zirconium-containing magnesium alloys at high temperatures in a carbon dioxide atmosphere before and after they had been heat-treated in hydrogen. Heating in dry carbon dioxide caused progressive grain coarsening and a corresponding drop in mechanical properties. Heat-treatment in hydrogen of alloys containing 0·3 to 0·6 per cent zirconium was found to result in the precipitation of zirconium from the solid solution in the form of an insoluble hydride phase. This had the effect of strengthening the alloy (increases in tensile strength, elastic limit and creep strength, but reduction in ductility), and very considerably reducing the rate of grain growth on heating, as compared with corresponding alloys which had not been heat-treated in hydrogen. This internal hydride hardening is analogous to the hardening by internal oxidation of alloys of silver or copper containing oxidizable alloying elements. The dispersion of the precipitated zirconium hydride phase is remarkably stable, because its coalescence is rendered difficult by its very limited solubility in the magnesium. As a result, the phenomenon of "over-ageing", which normally follows upon precipitation hardening, is, in this case, very slow and incomplete.

Critical Approach

ALTHOUGH the exact figure cannot be determined with any degree of accuracy, its absence does not affect the validity and significance of the claim that science and technology have made more progress in the past few decades (or whatever the exact number of years may be) than during the whole of the preceding period of recorded history. The exact rate of progress and the rate at which it is speeding up are difficult to determine for want of any exact criterion for evaluating and measuring progress. At this stage it would, perhaps, be advisable to remember that wise dictum which points to the dependence of understanding on the ability to measure, and leave discussion of progress and of its rate of advance until such time as investigations into the subject (assuming—a very big assumption this—that there are any) has succeeded in putting the matter on a quantitative basis. While awaiting the success of these probably non-existent endeavours, it would be a useful exercise to study the qualitative aspects of the phenomenon. Surprisingly enough, considering that we are all very much concerned or affected, one finds that even the qualitative aspects of the phenomenon are being taken for granted. Essentially, it is regarded as desirable and, therefore, as something to be pursued with all possible diligence. So far, there is no definite decision as to whether this pursuit is undertaken simply because it is regarded as desirable, from force of habit, or because there is no alternative. Then there is the question of continuity. Must the pursuit of progress be an unremitting day-to-day task and obeisance, or would occasional or periodic breaks be beneficial? There is evidence, gathered on occasions on which the pursuit was forcibly halted by lack of funds, that such halts can bring long-term benefits. Are we not, for example, all the better off without the monstrosities with which duplication, in the name of progress, in this country of the American heavy press programme of a few years ago would have left us? Could such breaks also be made to serve positive ends? Could they, for example, be used to provide sufficient detachment to allow us to consider, not merely the problem of where do we go from here, as is, in fact, already being done at present, but whether it would not be more profitable to occupy ourselves by not going anywhere.

Die Pressure Casting

GIVEN the task of producing a casting under pressure, somebody starting from scratch without any preconceived ideas could be expected to develop one or other of two basic techniques. One of them would be the technique of the pressure die-casting process as it is known today:—the injection under pressure of molten metal into a closed die. The other technique, which is much less widely known, and certainly much less widely used, would consist in placing the molten metal in an open die, and then closing the die and applying pressure to the metal in the closed die. Those interested in terminology may be left the task of deciding whether the products of these two processes could appropriately be distinguished by being referred to as pressure die-castings and die pressure castings, respectively. More practically and technically minded people might be prepared to accept the term liquid stamping of metal, given to the second process in Russia, where it appears to have been in use on a small scale, and go on to consider its advantages. In the form the process has taken in Russia, the required amount of molten metal is poured into an open die mounted on the table of a vertical press. A suitably shaped punch or core is then brought down and forced into the die by the operation of the press. The core carries a plate which closes the die, leaving a clearance for the escape of air and excess metal. The core continues to advance, applying pressure to the metal, until it reaches its final position. The solidifying casting shrinks on the core which, on being raised, withdraws the casting from the die and then brings it up against a stripper plate, which removes it from the core. A further development is the use of a composite die and core punch, which enables, for example, a hole to be punched in the bottom of a cup-shaped casting after it has solidified and before it is withdrawn from the die.

Skimmer

PROPERTIES — PRESENT KNOWLEDGE — CURRENT WORK — FUTURE OUTLOOK

The "New" Metals

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FROM the previous discussion it appears that, except for chemical applications, the material needs of modern engineering, taken as a whole, can be summed up as high strength with low density in the medium temperature range, and high strength with oxidation resistance at high temperatures. In the high temperature case the lowest density that can be combined with the other two properties must be added. Whether for high or low temperature uses, the required properties must be combined with sufficient ductility to render the material fabricable, and for nuclear energy applications neutron absorption must be taken into consideration. Although these requirements can be stated fairly simply, their fulfilment will be far from simple, and if success is to be achieved all relevant scientific knowledge will have to be called upon in order to ensure that the effectiveness of the research effort devoted to new materials is as great as possible.

To provide a starting point it may be of value to review what is known about the new metals. As already mentioned, beryllium is a fairly straightforward divalent metal having unusually high elastic moduli and a crystal structure in which slip is limited to the basal planes. Increased purity has, as is so often the case, brought improved deformability, but working remains difficult. For pure beryllium, the only lines of advance appear to be modification of manufacturing techniques and control of crystal arrangement in a way which permits the available slip planes to be used to maximum advantage. When alloying is permissible, attempts might be made to change the axial ratio of the hexagonal crystals, or to replace the hexagonal structure by a more ductile one. The latter alternative will be difficult, however, because for size factor and electrochemical reasons beryllium will tend to form intermetallic compounds of complex structure with other metals, rather than the simpler type of phase which might be expected to be ductile.

The other new metals can be considered as a group. All can exist in a body-centred cubic form (although titanium, zirconium and hafnium are hexagonal at low temperatures and chromium may be face-centred cubic at temperatures near its melting point) and all are ductile when pure. Embrittlement is caused in each metal by the absorption of interstitial impurities, but sensitivity to small amounts of impurity increases on passing across the Periodic Table from Group IVA to Group VIA. It seems reasonable to associate this increase in sensitivity with a corresponding decrease in the solubility of oxygen, nitrogen, etc., which occurs on moving from Group IVA to Group VIA, arguing that in elements such as titanium and zirconium, in which interstitial impurities are extensively soluble, small amounts of interstitials will be dispersed throughout the structure and that though they would cause hardening due to their impeding effect on slip processes a considerable degree of ductility would be retained; whereas in the Group VIA metals, in which the solubility of oxygen and nitrogen is low, interstitial atoms would accumulate in the disturbed region of the crystal lattice at the grain boundaries, and though the individual crystals would remain ductile, the bulk material would be brittle because of the occurrence of intercrystalline fracture.

Ductile : brittle transformations occur in the whole series of elements at temperatures depending on the amounts of impurities present. Even in commercially pure titanium and zirconium the transition temperature is below room temperature. Vanadium, niobium and tantalum, on the other hand, have to be specially purified in order to reduce the transition temperature to an equivalent level, though it is possible to achieve this without great difficulty.

Chromium, molybdenum and tungsten normally have transition temperatures well above room temperature, and though success has been achieved in preparing samples which are ductile at room temperature a considerable amount of research is still being directed towards the improvement of the room temperature mechanical properties of these elements. The addition of small quantities of other metals having very high affinities for oxygen and nitrogen, for example, has been tried as a means of removing harmful impurities from the grain boundaries, and some success has been achieved, especially with molybdenum.

Explanation of the decrease in the solubility of interstitial impurity elements on passing from Groups IVA to VIA may be sought in the relative sizes of the metal atoms and hence the dimensions of the interstitial space. As seen from Fig. 5, the atomic radii decrease markedly with increasing group number, and it could be suggested that in chromium, molybdenum and tungsten the interstices were too small to accommodate oxygen and nitrogen atoms, except at grain boundaries where the periodicity of the lattice is disturbed. Unfortunately, this simple picture is spoiled by the fact that the solubility of hydrogen in the early transition metals follows much the same pattern as that of oxygen and nitrogen, even though the hydrogen atom is so much smaller than those of the other impurities that it is unlikely to suffer from the same spatial limitations. Factors governing the dissolution of oxygen, nitrogen and hydrogen in the new metals appear, therefore, to be a very worthwhile field of study which could help to overcome the

Fig. 5—The atomic radii and crystal structures of the new metals

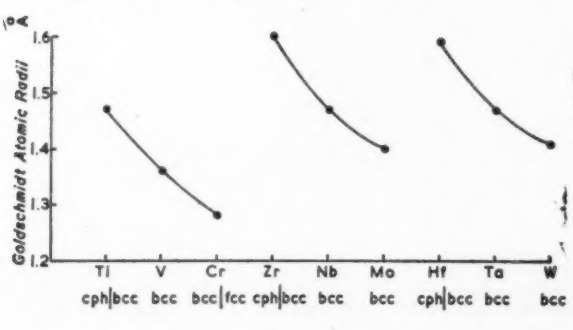
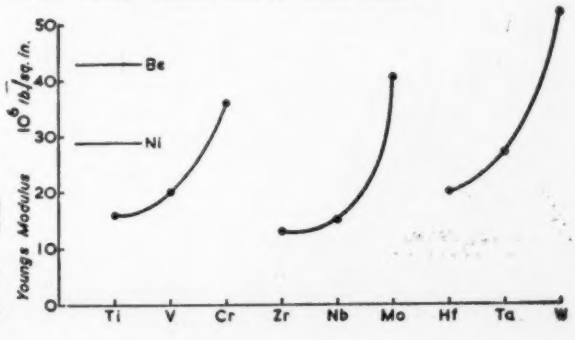


Fig. 6—Young's Modulus values for the new metals



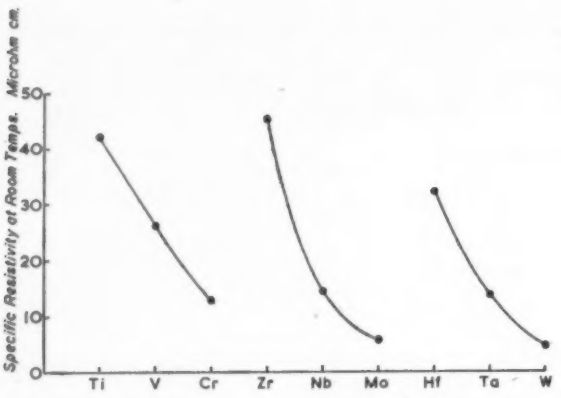


Fig. 7—Specific resistivities

fundamental difficulty of room-temperature brittleness.

Information is available on a number of the physical properties of the transition elements included among the new metals. It has been found, for instance, that Young's Modulus, which is low for Group IVA elements increases very markedly on moving from Group VA to Group VIA (Fig. 6). Electrical resistivity, on the other hand, does the opposite. As indicated by Fig. 7, specific resistivity falls markedly between Groups IVA and VA and less markedly between Groups VA and VIA, though even the Group VIA metals have high resistivities compared with those of non-transition metals. Magnetic susceptibility, on the other hand, is low for Group IVA elements, high for Group VA and low again for Group VIA.

It is obvious from the few examples given that the behaviour of the early transition metals conforms to an overall pattern. A number of attempts have been made to put forward a coherent theory of the whole series of metals based on the properties already mentioned together with others such as soft X-ray spectra and electronic specific heats. The value of the paramagnetic susceptibility of the non-ferromagnetic transition elements, for instance, is proportional to the density of energy states at the Fermi-surface, and the temperature coefficient of susceptibility is related to the first and second derivatives of the density of states. Thus it can be argued that in titanium and chromium, for which the temperature coefficient of susceptibility is positive, the Fermi energy lies close to a minimum in the density of states curve for the *d*-band. Unfortunately, however, it is not possible to deduce from a series of such arguments for each separate metal the shape of the whole density of states curve, since a *d*-band of any given shape is unlikely to apply to the group of elements collectively. Similar difficulties tend to be encountered in any approach to the theory of the transition of metals.

The position has been reviewed by Hume-Rothery and Coles[1], and more recently some further ideas on the electronic nature of the transition metals, based on data obtained from experiments on X-ray scattering together with the magnetic properties of transition metals and their alloys, have been put forward by Mott and Stevens[2]. No completely satisfactory picture has yet been formulated, however, and it appears that the next step forward must await the collection of sufficient experimental evidence, more particularly on the alloys of the transition metals with each other, to permit the formulation of a strong empirical hypothesis which can then be tested more rigorously.

Lack of a basic theory of the transition metals does not necessarily mean that the development of useful materials from among the new metals must be done without the help of the more fundamental ideas of metallurgy. In producing materials of high strength, for instance, much of the recent work on the deformation of metals is of the highest value, and if strength was the only criterion for a new material, it would probably be possible to produce what is needed without very much difficulty.

First principles applied to the oxidation problem, however, produce small results. Fundamental investigations of oxidation reactions have, indeed, been carried out, and it has been fairly clearly established that the protectiveness of an oxide film depends on its physical fit with the metal on which the film is formed and the difference between the temperature coefficients of expansion of metal and oxide. If the film is protective its rate of growth is determined by the rate of transfer of anions, cations and electrons through the oxide layer, the chemical potentials of oxygen at the metal-oxide and oxide-gas interfaces, and the electrical conductivity of the oxide. Though, like all theories, that of oxidation does not necessarily fit all the experimental facts, it is sufficiently well substantiated to make it possible to write a rough recipe for an oxidation-resistant alloy. It is quite another matter, however, to prepare such a material from the ingredients at our disposal.

It is in tackling the latter problem that the lack of a complete picture of the electronic characteristics of the metals is the most serious handicap. At present, hypotheses from which predictions regarding oxidation behaviour can be made must be built up by direct observation of oxidation processes in a wide range of metals and alloys, and only when sufficient experimental information has been collected will it be possible to estimate the chance of finding a sufficiently oxidation-resistant alloy among the new metals. On the other hand, of course, the next oxidation test carried out might reveal the ideal material, but it is not very likely.

An answer to the oxidation problem may require so fundamental a change in the character of the metals studied that there is a considerable danger of losing, partly or wholly the properties which make them of potential value as high temperature materials. It must be hoped that with the successful outcome to the oxidation work will come sufficient understanding of the factors involved to permit adjustments necessary to preserve the desired mechanical properties to be made without destroying oxidation resistance. The need to solve the two problems simultaneously is one of the strongest reasons for the emphasis placed on understanding at all stages in the process of alloy development. Without it, it would be very difficult to modify suitably an alloy found to have good oxidation characteristics but poor creep properties or vice versa.

Current State of the Work

Studies of the new metals aimed at high temperature materials have been going on, mainly in America, for the last five years or more, and work on beryllium and tantalum for a limited range of applications has been in progress for many more years.

Niobium research has revealed alloys which have oxidation resistance several hundred times better than that of the pure metal, which means that though the target has not yet been reached, there is good reason to believe that its attainment will be possible. The most oxidation-resistant materials prepared so far have had rather poor mechanical properties and have been difficult to work.

It is generally accepted that molybdenum-base alloys are unlikely to be of high-temperature use without a protective surface coating, and though coatings have been developed which are successful under some conditions, none has yet appeared which can withstand the rigours of the gas-turbine. Tungsten, which presents much the same problems as molybdenum is less far advanced.

Chromium has been held back by the handicap of room temperature brittleness. At one time it was thought that this might be an inherent characteristic of the metal itself, but intensive Australian work has shown that chromium can be ductile at room temperature if the nitrogen content is reduced to a very low level indeed. At present the very high purity material is prepared by a carefully controlled electrolytic process. If a larger-scale source of supply became available, development of chromium alloys would

be considerably encouraged, and though a year or two ago it was felt that the chances of ultimate success were slight there has been a recent resurgence of interest which may herald an important step forward.

The present position regarding vanadium is not hopeful. Thorough investigation of its oxidation behaviour led American workers to the conclusion that it was hopeless as a high-temperature material, and no developments have occurred elsewhere which could challenge this view. Some people, however, see vanadium as a higher-strength rival to titanium in the low-temperature field.

Tantalum, though not a favourite for high-temperature use, has sufficient promise to have justified some alloy development work in America, but no great progress has been reported. A good deal is known, however, about the preparation and fabrication of the pure metal.

Of the Group IVA elements, titanium and zirconium are established industrial metals and for titanium, at any rate, the alloys have been widely studied. Hafnium is only just beginning to come into the picture and little is yet known about it.

The toxicity of beryllium has confined work on this metal to a few special laboratories whose interests are such as to discourage publication of the results. The aircraft industry, however, is believed to be interested in the possibility of high-strength beryllium alloys, and if the metal eventually becomes available for non-nuclear purposes it is probable that alloy development work will have to be undertaken.

Future Outlook

In the foregoing discussion the difficulties of obtaining the new materials made necessary by modern technological development have been emphasized. The example of history suggests, however, that if the result is needed badly enough success will ultimately be achieved. The materials we now call new metals will always be expensive compared with the common constructional materials because of the basic difficulties of obtaining them from their ores, purifying the product, and melting and processing without contamination, quite apart from paying for the very large amount of research which will be needed to develop them to a useful state. But increased demand and the savings resulting from experience will very probably have their usual effect of reducing the price to an acceptable level, as has already happened to a large extent with titanium and zirconium. If and when this happens, the metals discussed in the present article will no longer be new, but will become a vital part of our transport and power producing industries.

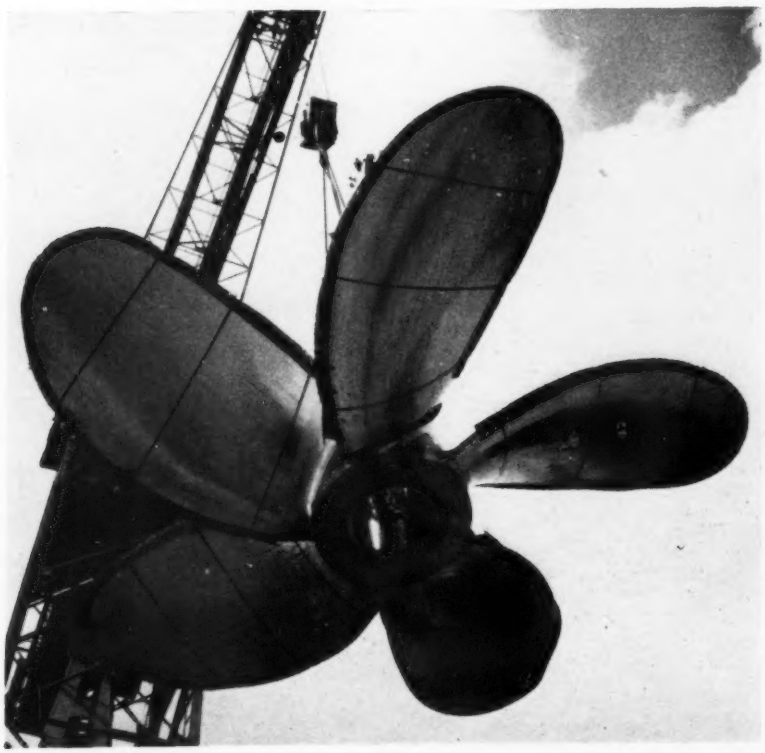
References

1 W. Hume-Rothery and B. R. Coles; Advances in Physics III, 149, 1954.
2 N. F. Mott and L. W. H. Stevens; *Phil. Mag.*, 8th Series, II, 1364, 1957.

Nickel-Aluminium Bronze Marine Propellers

IN August of this year, a five bladed propeller, the largest ever cast in nickel-aluminium bronze, was cast at the works of Lips N.V., Drunen, in Holland. With a net weight of 39 tons and a cast weight of about 50 tons, this propeller has a diameter of 7·5 metres, and it is to be used on a 72,600 ton super-tanker being built at Dunkirk by Ateliers et Chantiers de France for the Tidewater Oil Company. The super-tanker will be equipped with only one propeller which means that great care had to be taken in its manufacture and indicates the confidence the builders and the tanker's owners have in the performance of the propeller itself.

Weighing 39 tons, this nickel-aluminium bronze propeller has a cast weight of 50 tons



There are several reasons why this type of propeller is popular and why increased uses for nickel-aluminium bronze can be predicted. In 1942, after a series of failures of high tensile brass propellers, the use of nickel-aluminium bronze was recommended to the Admiralty, tested, and immediately adopted as the standard material for motor torpedo boat propellers.

Nickel-aluminium bronze is a lighter, yet stronger material than high tensile brass, and has a high resistance to corrosion fatigue in sea water. The thickness of the blades can be reduced without losing strength and this means less weight and more efficiency. In many cases a saving in weight of 20 per cent can be effected over the more conventional high tensile brass.

The reduced weight means less wear on shaft bearings, less power required and, of course, that a 2-ton saving in propeller weight enables a ship to carry two tons extra cargo. In the case of a ship burning 50 to 60 tons of fuel a day, increased propeller efficiency could mean a financial saving of at least £7 a day.

Finally, the very important matter of maintenance costs should be considered. Nickel-aluminium bronze has a greater resistance to corrosion and erosion than ordinary high tensile brass and since corrosion is metal's worst enemy in marine applications this factor is very important. The use of these propellers on the U.S. Navy's Arctic exploration voyages is an example of nickel-aluminium bronze's great strength and erosion resistance.

Atomic Progress

Uranium Dioxide Fuel

ADVANTAGES of uranium dioxide as a reactor fuel include its high melting point, its chemical stability with a wide range of reactor coolants, its ease of fabrication to high densities, compatibility with a variety of canning materials and an isotropic structure which is stable under irradiation. Against these must be balanced the disadvantages of low thermal conductivity and poor resistance to thermal shock. This article outlines some of the problems which face a fuel element designer wishing to develop a metal-clad uranium dioxide fuel.

Coolant Compatibility

Sintered uranium dioxide is stable in de-oxygenated high temperature water and shows only slight dulling after 300 days' exposure at 343°C. In water-cooled reactors traces of hydrogen are expected, due to reaction of the water with structural metals, and the UO_2 should be stable under these conditions. In CO_2 the oxidation of sintered uranium dioxide pellets is much less than that of uranium, being of the order of 0·01 mg/cm²/hr. at 700°C. compared with 400-600 mg/cm²/hr. for uranium metal. Thus, unless irradiation increases the reaction rate, there appears to be little to cause concern about the compatibility of CO_2 with UO_2. The compatibility of uranium dioxide with the conventional canning materials is good. Zirconium and UO_2 show no appreciable reaction below 700°C.; there is little reaction between aluminium and UO_2 below 500°C. and no reaction has been detected between either stainless steel or beryllium and UO_2 at temperatures between 600°C. and 700°C. Graphite appears to be compatible with sintered UO_2 at temperatures up to about 1,500°C. Hence it can be seen that the fuel element designer has a relatively wide choice of materials which are suitable for canning uranium dioxide, and which may be selected according to the reactor coolant. Thus, stainless steel is suitable for use with water-cooled, CO_2-cooled and organic-liquid-cooled reactors; zirconium is suitable for use with water-cooled and sodium-cooled reactors and aluminium-nickel alloys for certain water-cooled reactors. Beryllium is being developed in Great Britain for use in CO_2-cooled reactors. In almost every case there is a choice of two canning materials which has to be resolved in terms of strength and neutron capture cross-section in conjunction with the optimization of the whole reactor design.

Thermal Conductivity

The thermal conductivity of uranium dioxide is low, varying from about 0·008 w/cm/°C. at room temperature to about 0·002 w/cm/°C. at 1,600°C. In the temperature range applicable to operating fuel elements the thermal conductivity measurements vary by about 30 per cent. This leads to a larger uncertainty in calculated fuel temperatures. The limitation on fuel centre temperature has not yet been established. The melting-point of uranium dioxide is believed to be near 2,800°C. and no information appears to be available on the volume change associated with melting, so it is not possible to determine what void space should be provided in case the melting point is exceeded. Avoidance of centre melting means that fuel elements must be of thin section.

The oxygen content of uranium dioxide markedly affects the thermal conductivity, the values for near stoichiometric material being reduced by a factor of three for $UO_{2\cdot17}$.

The effect of irradiation on thermal conductivity is not clear. Measurements made during irradiation have indicated a decrease in thermal conductivity which may not occur until after a certain irradiation dose. Out-of-pile measurements on irradiated specimens have shown only small changes, less than 25 per cent decrease, after irradiation doses of up to 9×10^{17}n/cm². The in-pile and out-of-pile measurements have not been made on the same specimens so that structural differences, e.g., cracking and fragmentation, may be at least partly the reason for the low values of effective thermal conductivity obtained during irradiation. Alternatively, the explanation may be that during irradiation the conductivity is low because of point defects, which may anneal out when the irradiation is ended. Yet another possible source of the discrepancies may be variations in the fabrication techniques employed for the various specimens.

Fabrication

Uranium dioxide shapes can be fabricated from powder using conventional ceramic processes. The powder may be prepared by hydrogen reduction of a number of uranium compounds. Different methods of preparation yield powders with considerable differences in surface area, particle density and crystallite size and, in consequence, the sinterability of the powders is variable. Powders of poor sinterability can be compacted to high densities by the use of higher pressures and longer sintering times or by activation of the powder by wet ball-milling or fluid jet mill grinding before hydrogen reduction. Additives, such as TiO_2 and Nb_2O_5, have been found to increase the rate of sintering. Non-stoichiometric oxide sinters to higher densities for given conditions than does stoichiometric material.

The most common method of compaction is pressing with an organic binder to increase the green strength for handling. An alternative technique which has received some attention is swaging in Zircaloy-2 or stainless steel tubes. Densities of 10 gm/cm³ were obtained in this way with arc-fused uranium dioxide. High surface area powders gave lower densities. While the technique appears satisfactory using relatively thick-walled tubes (diameter: thickness ratio = 18 : 1) cracks have been found on the inner surface of Zircaloy-2 tubes with larger ratios, of the order of 40 : 1. The most reliable method at present for fuel element manufacture is to place sintered pellets inside a prepared tube and to fit end caps.

Cylindrical pellets are the most usual shape of fuel and these may be accurately ground to ±0·0005 in. However, tube tolerances are such that, for easy loading of the pellets, fuel-can gaps are required of several thousandths of an inch. The differential expansion of the fuel relative to the can will partially close the gap, the extent depending on the fuel temperatures. The residual gap would act as a barrier to heat-transfer and lead to higher central fuel temperatures than if there were no gap.

However, some recent tests in Canada indicate that the difference in fuel centre temperatures for fuel-can gaps of 0·017 in. and 0·005 in. may be as little as 100°C. The model employed to explain this is that the cracked segments of oxide (UO_2 frequently cracks under irradiation) move radially outwards to contact the can. In this way the interface temperature drop is then dependent only on the interfacial pressure and on the properties of the contacting surfaces. If this model is correct relatively large fuel-can gaps could be accepted in assembled fuel elements.

Under external pressure the stability of the thin-walled cans used for fuel elements is a problem. Thin walls are required from the point of view of neutron economy but, if too thin, the tubes will collapse and form ridges under the external coolant pressures. Canadian data indicate that tubes with larger diameter : wall thickness ratios than 30 : 1 are liable to collapse.

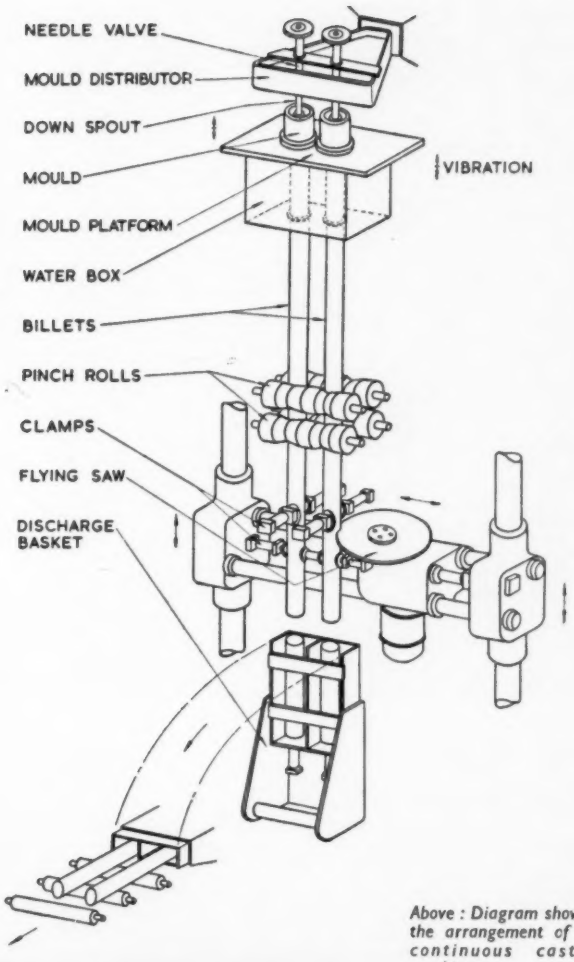
As an example, to avoid this problem with 1 in. diameter 0·025 in. thick tubes, it is necessary that the fuel pellet gap shall be less than 0·006 in. The fuel element designer has thus to design so that the fuel pellets can be loaded without undue difficulty into a tube

(*Continued on page* 323)

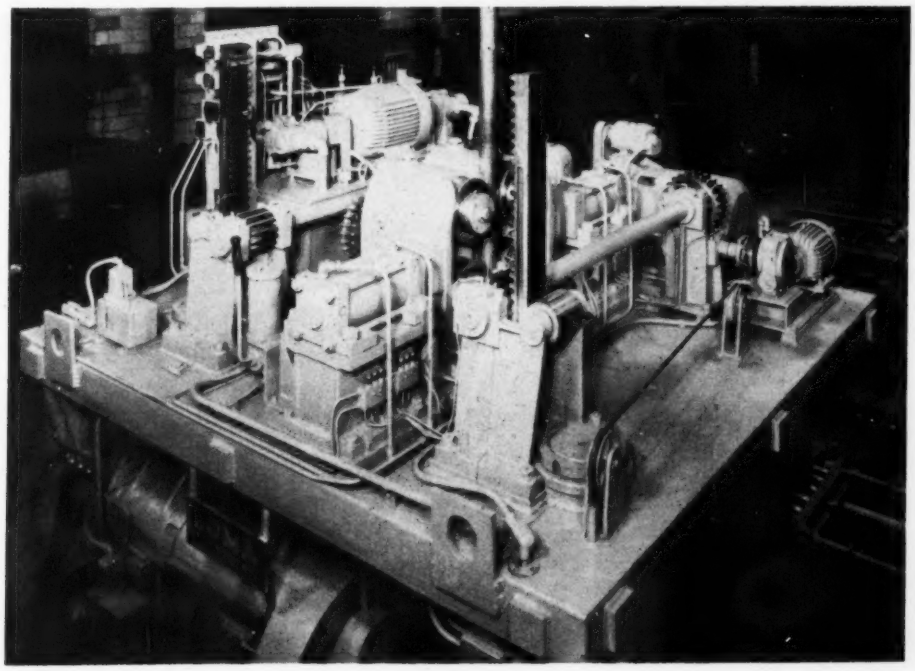
Continuous Casting Copper Billets

FOR continuous casting of copper in all its various forms—from phosphorus-deoxidized and oxygen-free to fire-refined and tough pitch—a copper billet and slab casting technique has been introduced by Loma Machine Manufacturing Co., Inc., of New York. The basic design of the machine also lends itself to the casting of brasses, bronzes, aluminium and magnesium alloys. The shapes produced on the unit include round piercing and extrusion billets, square wire bars and rectangular slabs. The production capacity of the machine ranges from 3 tons/hr. for double-strand casting of 3 in. diameter billets to 10 tons/hr. for single-strand casting of 5½ in × 33 in. slabs.

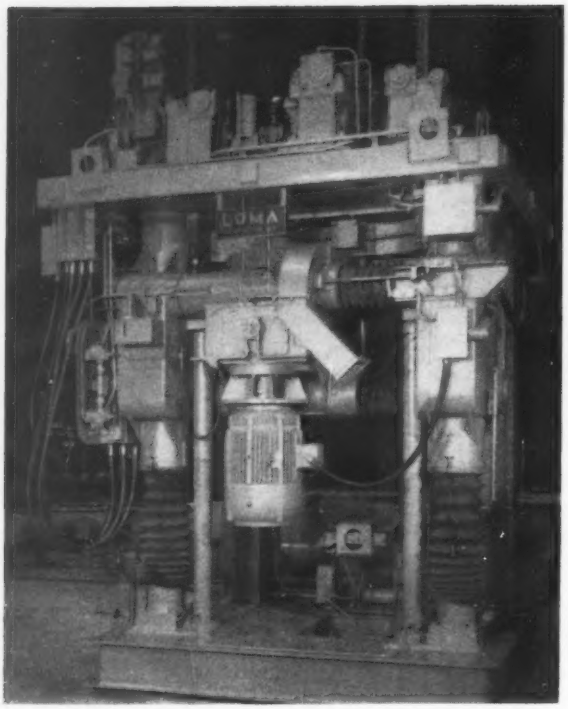
Metal is normally melted in either an arc or induction melting furnace with an induction furnace for holding. The molten copper at a temperature of 2,150°F. then flows through a special refractory-lined distributor equipped



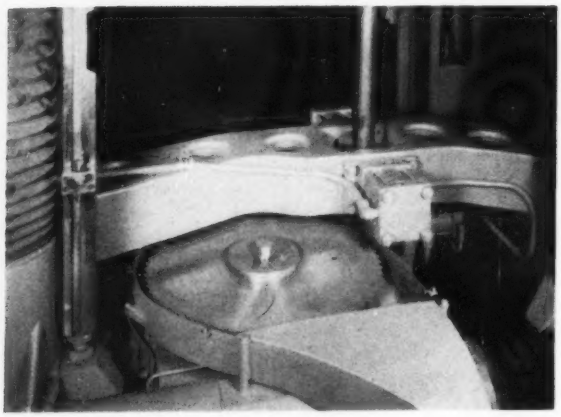
Above : Diagram showing the arrangement of the continuous casting machine



Left : Upper casting machine level, showing the withdrawal of a solidified billet by the two pinch roll sets. The mould distributor and inter-cooled mould are at a higher level



Left : Overall view of Loma continuous casting machine for the production of billets and slabs



Above : Close-up view of flying saw cutting through a billet being gripped by the double clamps

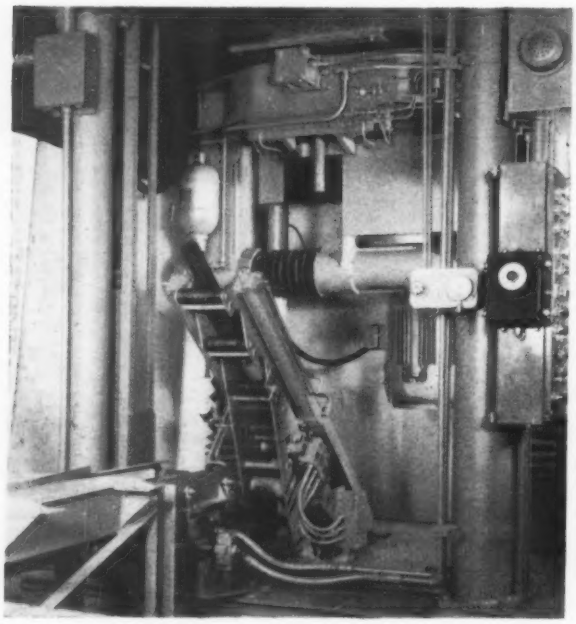
with down spouts extending into the moulds. The rate of flow of the metal through the down spouts extending below the metal surface is controlled by the operator with needle valves. This "underpouring" method assures a smooth, splash-free entry of clean metal into the mould cavity, thus eliminating internal porosity and inclusions in the cast material.

The billet, bar and slab moulds are of copper construction and are mounted at the top of the casting machine. The mould water jackets feature a special internal baffle design which greatly enhances their heat removal capacity. The cooling water initially flows through the mould jackets and then emerges from an adjustable slot at the mould bottom to impinge on the solidified metal surface in direct spray form. The spray water is collected in a water box mounted below the moulds and is recirculated.

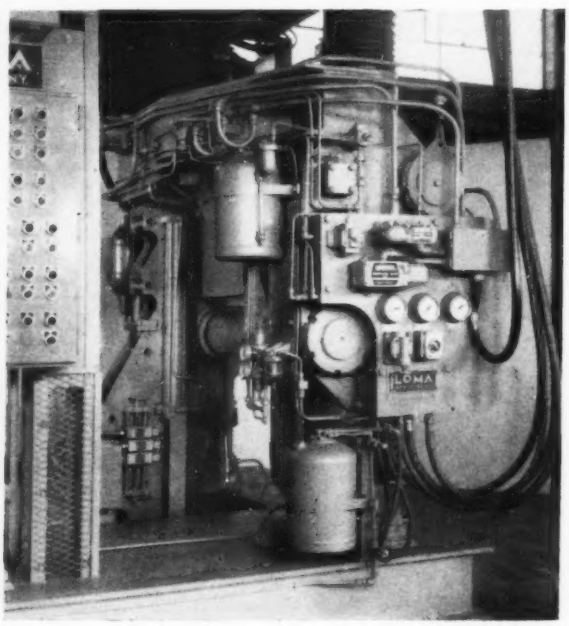
To prevent sticking of the cast copper to the mould and to assure a smooth metal surface, the entire mould assembly is oscillated by a reciprocating gear. The vertical stroke is only a fraction of an inch, and the rate of vibration can be adjusted up to several hundred cycles per minute by means of a variable speed drive.

The solidified metal strands are continuously withdrawn from the moulds by a double set of 9 in. diameter pinch rolls made of stainless steel. Proper clamping pressure is applied to the pinch rolls by opposed hydraulic cylinders and, in addition, spring pressure is provided to hold the stock firmly in cases of power failure. The pinch rolls are driven through reduction gearing by a 5 h.p. D.C. motor to

Lower casting machine level, showing a cut billet being removed by the tilting discharge basket



Operator's control station with electrical and hydraulic machine controls



obtain infinitely variable casting speeds up to 60 in/min.

Immediately below the withdrawing rolls and mounted on a travelling carriage is the flying circular cut-off saw. The vertical travel of the saw is along two of the four main columns of the machine, while its horizontal travel is along two columns on which the travelling carriage is guided. During cut-off, the descending castings are engaged by hydraulically operated clamps situated on both sides of the sawblade.

The saw employs a 36 in. diameter high speed steel segmental blade driven by a 40 h.p. motor at 1,200 ft/min. The cutting feed rate is adjustable up to 2 in/sec., while the return rate is 4 in/sec. The entire cycle of clamping, carriage descent, saw advance, saw and carriage return is automatic.

The cut billets or slabs are received in the discharge basket which is tilted automatically by a pneumatic cylinder through 90°. Once the basket reaches its horizontal position, the castings are ejected upon a roller conveyor by air cylinder action. Finally, an air-operated stamping device applies an identification mark to one end of each casting. The product is then removed to stockpile or immediate use.

Reader's Digest

TITANIUM

"The Analysis of Titanium and its Alloys." *Third edition. Published by Imperial Chemical Industries Ltd., London.* 1959. *Pp.* 119. *Price* 21*s.*

IT is just over two and a half years since the first edition of this publication was printed and it is evident, by the appearance of this latest edition, that the aim of Imperial Chemical Industries Ltd. is to keep the analyst, who has an interest in this field, abreast with the latest developments. It seems no more than a few years since titanium was a chemical and metallurgical curiosity but even before the metal assumed commercial importance the analyst was required to supply as much information as possible relative to the metal's chemical composition.

Over the intervening years the company's analysts have obviously gained considerable experience in this new analytical field and even a quick glance at this publication will convince the reader that the fullest use is being made of modern instrumental methods. For example, recommended procedures include the use of a flame photometer for the determination of sodium, an amperometric method for chlorine, a polarographic procedure for zinc and a semi-micro vacuum fusion procedure, which incorporates a molten platinum bath, for the simultaneous determination of oxygen and hydrogen; when hydrogen alone is to be determined a simpler, less expensive method, based on vacuum extraction, is advised.

The book can be divided into three sections, one covering chemical and physico-chemical methods, and including recommendations for the determination of twenty-four elements, ranging from aluminium and boron to zinc and zirconium. For some determinations more than one procedure is given; where this is so, the uses and limitations of each are briefly described and these descriptions serve as a guide in the choice between a rapid routine procedure and one which is intended to provide precise results without serious regard for the time involved. The remaining sections cover "spectrographic examination" and "spot tests" (chemical), both primarily designed for the identification of typical alloys.

All the recommended methods are those in use in the Metals Division of I.C.I. and have either been developed or had their reliability confirmed in the Division's Research Department.

The book will appeal to all analysts who have even a remote interest in the analysis of this relatively new metal and, in many respects, some of the recommended procedures are equally applicable to the examination of more common metallurgical materials.

W. T. E.

IRON AND STEEL

"The Manufacture of Iron and Steel" (Vol. II). *By G. R. Bashforth. Second Edition revised. Published by Chapman & Hall, Ltd., 37 Essex Street, London, W.C.2. Pp.* 390+*viii, with* 156 *illustrations. Price* 40*s.* 0*d.*

WHAT, it may be asked, is the most indispensable quality that a technical book should possess to win success? It must have precept and guidance for training education; its author must have sufficient knowledge and self-discipline to marshal his information clearly for the benefit of his readers.

The author of this book has revised his text and brought it more up to date than its original counterpart. He has not been able to deal fully with the Physical Chemistry of steel making, since this is a subject for the physical-chemist; nevertheless, the author does introduce some vital functions related to the physical chemistry of steel making which will be of considerable help to the student and reader.

The older methods of steelmaking are passing rapidly away; nitrogen, the unwanted element in Bessemer steel, is almost mastered, so that steel produced by a modified process is becoming favoured by all concerned. Bashforth deals with the oxygen enrichment of the blast, oxygen-steam, and the iron-oxide additions, all of which are used to reduce the air blowing cycle to minimize the embrittling nitrogen element in steel. The Kaldo process, using the oxygen lance blowing technique is also introduced in a later chapter on " Modification of steel-making processes."

Bashforth gives an excellent account of the basic process of steel making by the Bessemer, open hearth and electric furnace processes. Ingots and ingot production, ingot mould design receive the attention necessary and are thoroughly dealt with for all concerned. The manufacture of special steels does not receive the attention demanded in steel-making practice. Perhaps the author might have solicited the help of an expert in this field of steel making so that his book might have become a masterpiece in the world of text books on steel manufacture.

Many have already derived some lessons from the first edition of this work; lessons in organization, economics and the technique of steel manufacture. There are now new lessons to learn from this second revised edition. A book of this kind has been needed for a long time, for it is a sound textbook on the manufacture of iron and steel.

D. Ll.

Atomic Progress

—*continued from page* 320

with a thickness in relation to the diameter and fuel-can gap such that it will not collapse under the external pressures.

Irradiation Effects

Non-stoichiometric UO_2 has been found to exhibit more grain growth and of the order of 100 times greater fission product gas release than stoichiometric oxide. Presently available evidence indicates that the latter should be chosen for optimum performance. However, the behaviour of non-stoichiometric oxide is of importance as this could be formed if fuel elements become defective and expose the fuel to coolants such as water or CO_2. The release of fission gases from irradiated UO_2 is not fully understood. Oxides of similar density, but manufactured by different routes have given markedly different amounts of gas release and even in nominally identical samples the release has varied widely. Substantial gas release always seems to occur where grain growth is observed. Also low density oxides seem to give more gas release.

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J. R. Johnson; "Progress in Nuclear Energy, V," Metallurgy & Fuels, Vol. 2, Pergamon Press, 209.

Correspondence

Correspondence is invited on any subject considered to be of interest to the non-ferrous metal industry. The Editor accepts no responsibility either for statements made or opinions expressed by correspondents in these columns

Education in Metal Finishing

TO THE EDITOR OF METAL INDUSTRY

SIR,—Very often industrialists claim that they live from one crisis to another, but a crisis has recently arisen of which executives in the metal finishing industries may be unaware, and it is of such importance that it is essential to place the facts before them.

This crisis is concerned with education in metal finishing. For years the metal finishing industries have clamoured for the provision of educational facilities, with associated arrangements for examinations. After much detailed consideration and extensive inquiry by the City and Guilds of London Institute Metal Finishing Advisory Committee, two courses have been launched, one entitled "The Metal Finishing Practice Certificate" (Subject 17a), the other "Metal Finishing Technology" (Subject 17b). The first of these examination schemes has been integrated with the National Apprenticeship Scheme for the Metal Finishing and Allied Trades, and yet in spite of all the publicity efforts which have been made, the numbers of candidates taking the Metal Finishing Practice Certificate appears to be dwindling year by year. The figures for the last three years are as follows:

1957	-	-	40 candidates
1958	-	-	31 "
1959	-	-	25 "

During 1959, candidates were submitted from only three Colleges, two in the London area and one in the Midlands. The examination in Metal Finishing Technology is a more recent introduction and in 1959 there was only one candidate. It should also be made clear at this point that there is no other scheme of examinations which cover the same field.

It should also be emphasized that the City and Guilds of London Institute do not insist that a candidate should attend a College for instruction, if for reasons of geography his private address prevents this. Arrangements have always existed whereby students may enter as private external candidates, and in certain subjects such candidates have done themselves considerable justice.

To the examining authorities the lack of candidates is taken to imply that the courses are not required by Industry, and so a situation has now arisen in which, because of such small support, the City and Guilds of London Institute may find it necessary to discontinue offering examinations in the two subjects named above. Should this happen it must be stated most emphatically that it would be a national calamity as far as the metal finishing industry is concerned, and yet what is to be done? What does Industry want? Does Industry want anything at all?

It is hardly just to criticize the colleges, because if a course is to be organized considerable expense has to be incurred in respect of making accommodation available, and in the provision of the necessary equipment. Naturally, college principals are very loath to embark upon recommendations to their Local Authorities without having been able to obtain more or less definite guarantees of support from local industry.

It is submitted that if industrial executives really want their industries to survive, let alone go forward with development projects, it will be vitally necessary for them to have passing through their metal finishing departments a steady stream of practically trained and theoretically qualified young men. The theoretical training of such young men the technical colleges can give if industry is willing to support courses when started.

All industrial executives are urged, therefore, to consider the position as it now exists and to endeavour to send some of their employees to selected technical college metal finishing courses.

The situation is an urgent one for the metal finishing industry and calls for an immediate response.

As a contribution towards solving the problems which face the industry the writer would be only too glad to discuss specific problems with personnel managers and other industrial executives should they desire it.

J. E. Garside,
Chairman,
Education Committee.
Institute of Metal Finishing,
32 Great Ormond Street,
London, W.C.1.

Men and Metals

It has been announced by Birlec-Efco (Melting) Limited that **Mr. C J. Beavis** has been appointed to take charge of all Birlefco's smelting activities. Formerly works engineer for the Distillers Company Limited at their factory near Port Talbot, Mr. Beavis was responsible for all engineering construction and maintenance required for the production of calcium carbide.

Consequent upon the recent death of Mr. R. B. Dakin, who was deputy chairman and joint managing director of Walter Somers Limited, the following changes of office have been made in the board: **Mr. Walter Somers** has been appointed deputy chairman and joint managing director; **Mr. A. C. Somers** has been appointed sales director; **Col. T. V. Somers,** O.B.E., is production director, and **Mr. W. M. Grainger,** secretary, and **Mr. D. D. Carrington,** engineer, have both been appointed to the board of directors. **Mr. D. C. Tyson,** until now in charge of the light forge, has been appointed assistant to Col. T. V. Somers.

News from the Pressed Steel Company Limited is that **Mr. Cecil F. Tracey** has joined the organization as a divisional director of the Prestcold Division, with the title of production director of the new Swansea plant.

Changes in the senior executive positions of Union Carbide Limited have been announced as follows:—**Mr. L. E. Whitmore** becomes director and general manager, polythene division, with responsibility for marketing, manufacture and all other aspects of the company's activity in this field; **Mr. J. F. Widman,** previously director of marketing, chemicals, becomes director and general manager of the chemicals division, responsible for the manufacture and sales of products from the new plant at Hythe, and also for continued development of the market for imported chemicals; **Mr. R. Wilson** has been appointed a director of Union Carbide Limited, and becomes director and general manager, alloys division.

Secretary of United Gas Industries, **Mr. J. W. Baggett** has been appointed to the boards of the subsidiary companies—Dowson and Mason, Metal Units, and Vacuum Metallurgical Developments.

The Minister for Science has appointed **Professor Char'es Frederick Carter** to be a member of the Council for Scientific and Industrial Research. He takes the place of **Professor E. A. G. Robinson,** who retires on completion of his period of service. Professor Carter is Stanley Jevons Professor of Political Economy and Cobden Lecturer in the University of Manchester.

Recently appointed to the board of Edgar Allen and Company Limited are **Mr. J. Higginbotham, Mr. W. G. A. Jenkins** and **Mr. F. A. Ross.**

It is understood that **Mr. A. S. D. Barratt,** technical director of Edwards High Vacuum Limited, is to resign at the end of this year to become an independent consultant. He will retain an association with the company as technical consultant.

New Plant & Equipment

Mould Drying

BY an agreement with Brown Boveri and Co., Ltd., of Switzerland, the Electric Resistance Furnace Co., Ltd., a subsidiary of Efco Ltd., are to manufacture portable electric mould driers of the Brown Boveri design.

These driers operate by forcing hot air not merely over the mould surface but through the sand itself, giving quicker and more efficient drying than is achieved with hot gases from fuel-fired stoves. Using air temperatures some 100°C. to 150°C. lower than the hot gases, and less than one-third the quantity of heat, they have reduced drying times by a half and in some cases by two-thirds. The heating is uniform throughout the mould and despite the rapid drying, mould surfaces remain free from cracks and cleaner castings are produced. The driers need no attention during operation, the power input being regulated automatically to maintain the desired air temperature. Working conditions are improved by the elimination of smoke and burning gases.

Large cores can be inserted in the moulds and dried at the same time, the castings then being made without re-opening the moulds.

The drying equipment consists of an electric air heater, a fan and driving motor, and control gear, all of which is assembled into a single compact unit. The air is heated by being passed at great speed through ceramic tubes containing spiral-wound heating elements. The fan is fitted with a radially-bladed impeller and a suitable diffuser, the impeller being mounted on a specially strengthened motor shaft. The motor is completely enclosed to protect it from dust and moisture. A single switch is used to bring the drier into operation and to adjust the power input. The air temperature is controlled by a pointer-type mercury thermometer, with minimum and maximum contacts, which switches elements on and off as necessary. A manometer measures the static pressure in the mould and indicates the density of the mould and the porosity of the sand.

A mould to be dried is covered as for casting and the drier is placed in position over the casting gate. All openings, with the exception of the core and coke bed ventilation channels are closed. With the drier in operation, hot air is forced through the mould sand where it gives up its heat and passes out through the ventilation channels saturated with steam. The absence of steam indicates that drying has been completed.

The Electric Resistance Furnace Co. will be manufacturing the driers in three ratings of 25 kW., 70 kW and 140 kW., and in two temperature ranges, one for use in grey-iron and other metal foundries where temperatures up to 350°C. are sufficient, the other providing temperatures up to 650°C. for use in steel foundries.

Polishing

DESIGNED for a wide range of cylindrical workpieces, including wire and tube drawing dies, etc., a recent addition to the Rudkin and Riley range of equipment is a hand polishing machine (model 2006/3).

The standard machine is fitted with an adjustable handrest and aluminium chuck guard. Design features include large taper roller bearings, convenient lubricating points, and overall sturdiness to give long and trouble-free service.

Chucks up to 7½ in. can be fitted and the speeds available are 2,400 and 3,150 r.p.m. (2,850 r.p.m. motor) and 1,200 and 1,575 r.p.m. (1,425 r.p.m. motor).

The machine is supplied complete with electrics, and extra equipment, which is optional, comprises electromagnetic brake, low voltage lighting, and a cast stand as an alternative to bench mounting.

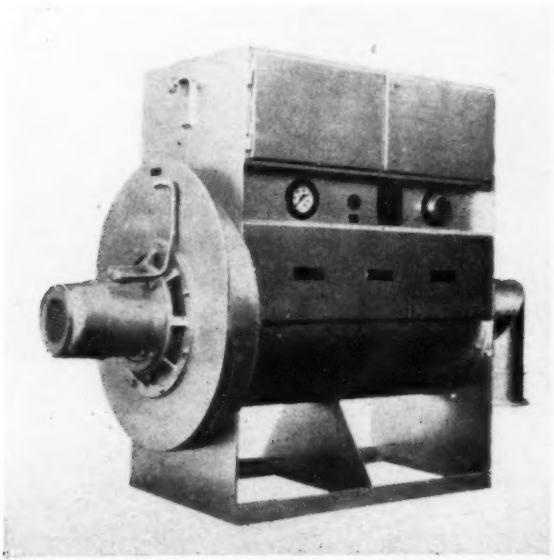
Dimensions of the machine shown in the accompanying illustration are as follows: length 28 in., front to back 33 in., height 50 in.

The manufacturers are Rudkin and Riley Ltd., Cyprus Road, Aylestone, Leicester.

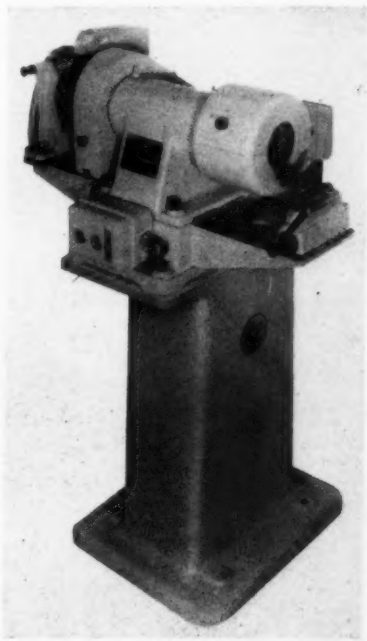
*p*H Metering

INCREASED numbers of instruments required in modern process control has led to the development of a whole range of miniaturized instruments for measuring temperature, pressure, level and flow. An industrial *p*H meter in this form has now been introduced by Electronic Instruments Limited, of Richmond.

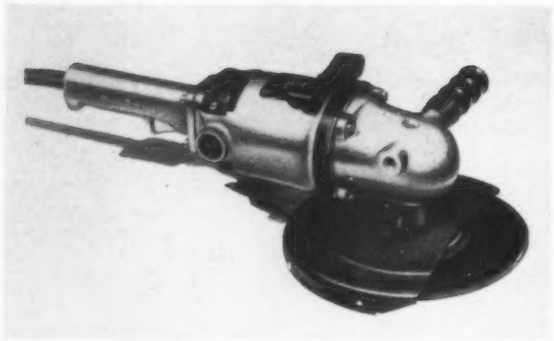
This new version of their standard industrial *p*H meter occupies 60 per cent less panel area and may be used in conjunction with any of the



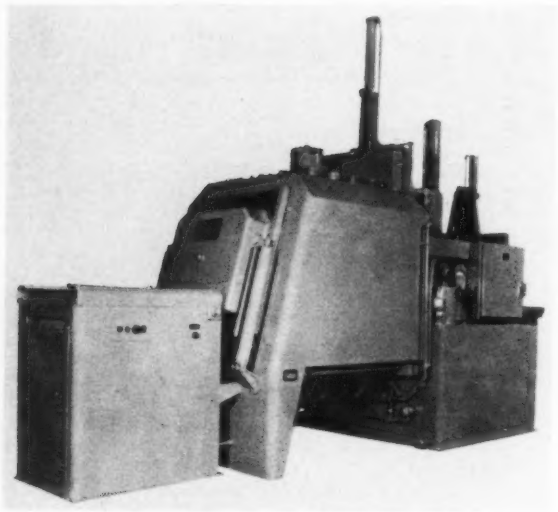
Left : 70 kW portable electric mould dryer of the Brown Boveri type to be manufactured in this country by the Electric Resistance Furnace Co. Ltd.



Right: Hand polishing machine Type 2006/3 made by Rudkin and Riley Ltd.



Above : Heavy duty angle grinder by Black and Decker Ltd.



Right : Ipsen Model B straight-through heat-treatment unit

conventional miniaturized recorders or controllers.

The performance of the miniaturized *p*H meter is identical to that of the standard instrument and servicing may be carried out by simply opening the glass fronted door and withdrawing the entire chassis.

Angle Grinding

INTRODUCED to fill the need for an exceptionally sturdy portable grinder, the Black and Decker Heavy Duty Angle Grinder can be adapted for use with 7 in. and 9 in. sanding discs, saucer grinding wheels, wire cup brushes or planer heads. High speed models are specially designed for use with 7 in. or 9 in. cut-off wheels and depressed centre grinding wheels.

Three models, with speeds of 4,200 5,200 and 6,000 r.p.m. respectively, are available. The $\frac{5}{8}$ in. diameter spindle is threaded 11 t.p.i. The overall weight is 14 lb. and the length 18$\frac{9}{16}$ in.

Standard equipment includes 3-core cable, 3 medium sanding discs, 5 in. moulded rubber pad, clamp washer, reversible side handle, stand, and spanner wrench.

The makers of this grinder are Black and Decker Ltd., Harmondsworth, Middlesex.

Heat-Treatment

MARQUENCHING, normalizing, annealing and brazing, as well as other heat-treatment processes, can be performed in sealed quench units now being marketed in this country by Ipsen Industries Inc., 53 Victoria Road, Surbiton, Surrey. The design anticipates the trend to higher and higher temperatures in furnace operation.

The straight-through design contributes to more efficient heat-treatment and features of the Ipsen units include no in-and-out interruptions, direct access to the furnace from both ends, and straight-through work flow helps to avoid mixing treated with untreated work.

Some notable features of the design are the use of light baskets or trays of wrought Inconel, automatic loaders requiring only 6 in. more floor space than the actual work basket, special silicon carbide hearth, side baffles and connecting arch arranged to ensure even heat distribution, and ceramic heating tubes in improved mountings.

All models are available as gas- or electrically-heated units. In gas-fired furnaces, premix burners give complete combustion in the heating portion of the tube and ceramic "flame-busters" increase the effective flame length.

Air-hydraulic movements are provided for door and quenching operations, and automatic dewpoint control is incorporated.

Casting Titanium

IN a study of melting and casting titanium, consumable electrode arc melting in a vacuum of less than one micron has been applied at the United States Naval Research Laboratory. Two types of furnaces have been employed to prepare ingots and cast shapes for metallurgical evaluation.

Compressed titanium sponge electrodes are melted in one arc furnace to form an ingot which is solidified in place in a water-cooled copper crucible. This ingot material is then joined to form an electrode for a skull furnace. Power input into this skull-type furnace of up to 300 kW is required to maintain a large enough volume of molten metal sufficient to cast up to 100 lb. of titanium. The molten metal is discharged by pouring over the lip of the crucible within 5 sec. after the power cut-off.

Studies of the effects of running, gating, and risering upon the solidification of simple shapes of titanium cast into machined graphite moulds showed the problem of shrinkage porosity to be of prime importance.

In view of excessive grain growth which occurs in as-cast titanium in sections over 1 in. in cross-section, the mechanical properties of such material were compared with forged and rolled material of the same quality, and found to be comparable.

The effects of vibrating titanium during solidification at a frequency of 120 cycles/sec. were studied to determine if such treatment would either reduce the grain size or the porosity in titanium castings. No significant effect was observed.

In high-temperature measurement tests, results obtained with a graphite-tungsten thermocouple system show a promise of success.

Obituary

Mr. R. B. Dakin

WE regret to record the death of Mr. R. B. Dakin, deputy chairman and joint managing director of Walter Somers Ltd., of Halesowen, Worcs. Mr. Dakin had been 46 years with Walter Somers Limited, and had held a succession of posts, including those of manager of the original Haywood Forge, secretary of the company, works manager, and then managing director.

Mr. A. A. King

WE also regret to record the death of Mr. Alfred Alexander King, formerly managing director of Albright and Wilson (Manufacturing) Ltd. He joined the company in 1900 and became works manager shortly after 1918. Later he became technical director and was appointed as managing director shortly before the Second World War. He retired from active business in 1942.

Industrial News *Home and Overseas*

Detergents Company

Following our previous announcement that **Reddish Detergents Ltd.** has been formed to take over certain commitments previously handled by the Reddish Chemical Company Ltd., we now learn that among the range of detergents for which this company will be responsible are several for use in the metal working industries.

Electric Smelting

An announcement has been made by **Birlec-Efco (Melting) Ltd.** concerning the pilot plant which has been commissioned for their Aldridge headquarters. This plant is intended to test the amenability of customers' raw materials to electro-thermal reduction, and to determine the most suitable smelting technique and the nature of the products obtained.

A Scottish Branch

A company which advises industry on the appointment of senior managerial and technical staff is **Management Selection Ltd.**, and this company has now opened a Scottish headquarters at 212 West Regent Street, Glasgow.

The company has for some time advised many Scottish firms, but with the increase in the development rate of industry north of the border, it was found necessary to establish this new branch.

Tin Stocks

Statistics issued in Singapore show that Malaya's stocks of tin concentrate at the end of September last amounted to 13,858 long tons. This compares with 13,176 long tons at the end of August.

An Aluminium Building

Appropriately, a new building which houses the bulk of virgin aluminium and alloy ingots imported into Britain by **Alcan (U.K.) Limited,** is made of—aluminium. The company's new distribution depot at Redstone Wharf, Stourport, Worcestershire, replaces a depot at Hockley, Birmingham. Although only 20-odd miles from Birmingham and Wolverhampton, the new depot stands on the banks of a rural and picturesque stretch of the River Severn.

The river provides the means of transport for most of the incoming ingots. They arrive by barge along some 80 miles of waterway from Avonmouth, having travelled from Canada. From the depot the ingots are despatched by road to the company's own works at Handsworth, and to other users all over the country.

The main building of aluminium sheets was supplied by Coseley Buildings Ltd. The framework of galvanized steel is of the Coseley standard pattern, which has particular advantages for a storage building since it provides a clear headroom which permits high stacking of bundles of ingots. Verticles which taper to the floor provide maximum floor space. The building is 125 ft. long by 75 ft. wide, and is 15 ft. high to eaves. It is used principally for the storage of alloys. Virgin metal is, for the most part, stored in the open. The building is fitted with Cerapane roof lights supplied by Saunders Roe, providing an unusual degree of light.

It was not blind loyalty to their own product which led Alcan to choose a building of aluminium. The choice was made because of its durability and appearance. The stucco-finish sheets have a pleasing matte finish. When completed early next year, Redstone Wharf will have its own unloading quay, served by a crane. Until then, supplies are unloaded from the barges at a nearby quay of the British Transport Commission. Our photograph is of a corner of the new depot showing the high stacking made possible by the clear eaves space of the building.

Powder Metallurgy

Arranged by the Powder Metallurgy Joint Group of the Iron and Steel Institute and The Institute of Metals, an all-day Symposium on **"The Powder Metallurgy of Magnetic Materials"** will be held in the Hoare Memorial Hall, Church House, Great Smith Street, London, S.W.1, on Wednesday, December 16 next, starting at 9.30 a.m. and, after luncheon, at 2.30 p.m. A number of Papers, describing original work, which will be introduced by rapporteurs, will be presented and discussed.

In the evening, an informal conversazione will be held at the headquarters of The Institute of Metals, 17 Belgrave Square, London, from 7.30 to 10.30 p.m. Tickets, price 10s., including light refreshments, may be obtained from the Secretary, Powder Metallurgy Joint Group, at 17 Belgrave Square. Visitors will be welcome at both the Symposium and conversazione, but tickets for the Symposium are not required.

Bronze and Brass Founders

On Tuesday, December 1 next, Mr. W. H. Davies is to give a talk to members of the **Association of Bronze and Brass Founders** at the Union Club, Newcastle, at 6 p.m., on the subject of "Costing a Casting".

"Costing a Casting" has been produced at the request of members of the association for guidance on costing, and sets out a method of costing and estimating which is practical and which can be operated with the minimum of staff; indeed, in many cases no increase in staff would be required. It has been specially compiled with the needs of the smaller firms in mind.

Copies of this publication may be obtained from the association at the price of £1 10s. 0d., including postage.

Lithium Stearate

In view of a short note entitled "Sintered Brass", which appeared in the issue of this journal for November 6 last (page 286), and in which the use of lithium stearate as a compacting lubricant was referred to, we understand that **Durham Chemical Limited** produce lithium stearate, and that Durham Raw Materials Ltd. are the sales division of that company. This latter concern would be pleased to supply a sample in any size or quantity of a suitable material to interested firms.

Tin Stockpile Sale

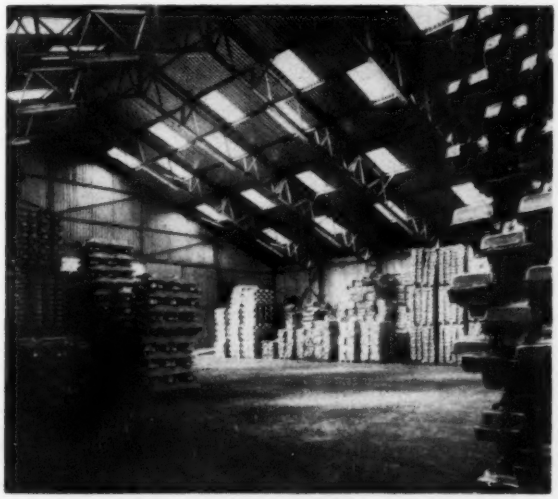
It was announced by the Board of Trade at the end of last week that arrangements had been completed, subject to the formal agreement of the International Tin Council next month, for the sale of the Board's remaining stocks of about 2,500 tons of tin, to take place through the Buffer Stock Manager of the Tin Council. The tin would be available to him from December 28 next.

World Tin Statistics

World mine production of tin-in-concentrates in July 1959 declined to 10,900 tons from 11,600 in June, the International Tin Council reports in the October issue of its monthly statistical bulletin. Production in May totalled 11,500 tons. In August, production increased in Indonesia (1,712 tons), but declined in the Federation of Malaya (3,046 tons).

World smelter production of tin metal (including estimated output in the United States) fell to 9,500 tons in June from 10,100 in May. World production in July is provisionally estimated to have risen to 12,300 tons (including an estimated 1,750 tons for the United States).

World consumption of primary tin



A corner of the new depot for Alcan (U.K.) Limited

metal is estimated to have fallen to 12,400 tons in July from 15,200 in June. Consumption fell to 3,210 tons in the United States, from 4,995, and to 1,682 tons in the United Kingdom from 1,987.

The full effects of the United States steel strike on tin consumption became apparent, the Council says, in August, when total usage in the United States dropped further to 2,185 tons. Consumption in the United Kingdom in August, at 1,224 tons, was also appreciably lower. Provisional figures for the seventh control period (July 1 to September 30, 1959) show that 2,257 tons of tin were exported from the Belgian Congo and Ruanda-Urundi, and 1,522 tons from the Federation of Nigeria.

Metal Finishing

Readers are reminded that the annual general meeting of the **Institute of Metal Finishing** is to be held on Monday, November 30, at the Charing Cross Hotel, London. At this meeting, Mr. A. A. B. Harvey will give his presidential address.

Atomic Waste

A six-day meeting began on Monday last at Monte Carlo, where a large number of scientists and atomic energy experts are to study the problem of the safe disposal of radioactive waste. Great Britain is represented at this meeting, which is being attended by delegates from about 30 countries.

As far as Great Britain is concerned, the Radioactive Substances Bill, which was published last week and is sponsored in the House of Lords by the Lord Privy Seal (Viscount Hailsham), will require those people who keep or use radioactive materials to register. The Bill is designed to improve control over discharge of radioactive waste.

In general, it will be illegal to accumulate or dispose of radioactive waste except in accordance with authorizations given by Government Ministers. Penalties for contravention of any clauses in the Bill may be fines or imprisonment.

U.S. Duty on Magnesium Alloys

It is understood that the Bureau of Customs, United States, have given notice of a prospective alteration in the classification, for duty purposes, of magnesium alloys. The notice, published in the *Federal Register* on October 28 last, reads as follows:

'It appears probable that a correct interpretation of the provision for magnesium alloys in paragraph 375, Tariff Act of 1930, as modified, requires that certain alloys not in chief value of magnesium, i.e., an alloy in ingot form containing 80 per cent magnesium and 20 per cent thorium, in chief value of thorium, and an alloy in sintered pellet form containing 60 per cent magnesium and 40 per cent zirconium, in chief value of zirconium, be excluded therefrom, and classified as articles not specially provided for, manufactured, composed in chief value of other metals, under paragraph 397, Tariff Act of 1930, as modified and dutiable at the rate of 22½ per centum *ad valorem*.

'This would result in the assessment of duty on such alloys not in chief value of magnesium at a rate of duty higher than has been assessed on them under an established and uniform practice.

'Pursuant to s. 16.10a(d) of the Customs Regulations, notice is hereby given that the existing uniform practice of classifying such merchandise as magnesium alloys under paragraph 375, Tariff Act of 1930, and dutiable at the rate of 20 cents per pound on the metallic magnesium content and 10 per centum *ad valorem* is under review in the Bureau of Customs.

'Consideration will be given to any relevant data, views or arguments pertaining to the correct tariff classification of such merchandise which are submitted in writing to the Bureau of Customs, Washington 25, D.C. To assure consideration, such communications must be received in the Bureau not later than 30 days from the date of publication of this notice. No hearings will be held.'

New H.Q. for British Engine

A well illustrated brochure in colour has just been issued by **British Engine Boiler and Electrical Insurance Company Ltd.**, giving a general description of the new headquarters which have recently been completed for the company, and also some details of the history of the concern which was founded in 1878.

The new headquarters is the first building to be completed on a site bounded by Corporation Street, Cannon Street, Victoria Street and Market Street, Manchester, and consists of a basement, ground and seven upper floors. The building is of steel-frame and concrete fireproof construction. Departments and offices are divided by movable glazed partitions of aluminium framework, with insulated panels. Included in the various departments is the research department, which is available to all other engineering sections of the business, and which also has its own laboratories, equipped for metallurgical and chemical examinations.

U.K. Metal Stocks

Stocks of refined tin in London Metal Exchange official warehouses at the end of last week fell 449 tons to 7,131 tons, comprising London 4,384, Liverpool 2,575 and Hull 175 tons.

Copper stocks rose from one ton to 6,808 tons and were distributed as follows: London 1,474, Liverpool 3,584, Birmingham 75, Manchester 1,575, and Hull 100 tons.

Tin from Singapore

Tin shipments from Singapore during the first half of November amounted to 3¾ tons, according to the Straits Trading Company. This compared with 5½ tons shipped in the first half of October, and 41¼ tons in the first half of November 1958. The November first half total comprised Pacific 2 tons, India ¼ ton, and the Middle East 1 ton.

Penang tin shipments in the November first half amounted to 2,561¼, compared with 2,138½ in the first half of October, and 1,320 in the first half of November 1958.

The November first half total comprised the United Kingdom 47½, United States 1,235, Europe 241, Japan 513, Pacific 78, India 237¼ South America 57½, Africa 24, Australia 115 and the Middle East 13 tons.

Meeting in Düsseldorf

Particular significance attached to the recent Congress of the **Bureau International de la Recuperation,** which was held in Düsseldorf last month. The enforcement of the European Common Market and the establishment of the European Free Trade area may both have a repercussion on the international flow of waste trade materials, and especially in the field of non-ferrous scrap metals.

The meeting of the Non-Ferrous Metal Section of the Bureau was attended by 26 delegates representing nine countries, and for the first time a delegation from Morocco was present. Mr. Doisy, general delegate, gave a report on the relationship with the Non-Ferrous Committee of the O.E.E.C., and he reported that the B.I.R. Non-Ferrous Section had now been recognized as a consultative body and is to be invited to attend the meetings of the O.E.E.C. Non-Ferrous Committee.

Mr. Valton, general secretary, gave a brief report on the meeting held in Vienna in June last by the Association of Steel Tubes and Metal Merchants, at which several members of the B.I.R. Non-Ferrous Section were present.

Mr. Renier reported on the current negotiations in the C.E.E. Committees, and the Technical Committee reported that it had now prepared a list of additional specifications which it is proposed to add as a supplement to the N.F.58 list. These are now being considered by the different countries for approval.

A Useful Map

From the Department of Mines and Technical Surveys, Ottawa, comes a most useful wall map, in colours, on which is depicted the various non-ferrous smelters and refiners in Canada, also iron blast furnaces, ferro alloy plants, and a great deal of other valuable information to the metal working industries. There is also an index to the principal producing areas sub-divided into their respective Provinces of the Dominion, including Newfoundland.

Nickel + Chromium Plating

On the leader page of METAL INDUSTRY this week (page 315) the Mond scheme for quality labels on chromium plate is discussed, and we are here able to give an illustration of the goods label which

has been produced for use in this connection. This goods label is to be taken as an indication that the plating is to one of the three grades of the British Standard.

Aluminium in U.S.S.R.

Russia exported 114,900 tons of aluminium last year compared with 85,400 tons in 1947 when she ranked second only to Canada as a world exporter, said Mr. G. A. Vvedensky of the Institute for the Study of the U.S.S.R., in New York, over the weekend. In 1957, over 70 per cent of Soviet exports went to the satellite countries.

An approximate estimate of Soviet aluminium output could be compiled from various Soviet sources, Mr. Vvedensky said. He estimated output in 1950 at 200,000 tons, rising to 560,000 tons in 1955 and 930,000 tons in 1958. With an increase of 208 per cent scheduled under the Seven Year Plan, output should reach 2,600,000 tons a year in 1965.

"There are at present 10 working aluminium plants in the U.S.S.R., and

three more are in the process of construction. It is planned that Siberia and Kazakhstan will become the main suppliers of aluminium, ousting the European part of the U.S.S.R. and the Urals. By 1965, the chief purveyors of aluminium will be Krasnoyarsk, the village of Shelikhovo, near Irkutsk, Kuznetsk in the R.S.F.S.R., and Pavlodar in the Kazakh S.S.R."

When these plants were completed, Mr. Vvedensky said, there should be a 21 per cent reduction in production costs compared with 1959. "At present, one ton of aluminium costs 10 per cent less to produce than one ton of copper, 35 per cent less than lead and 20 times less than tin. In addition, the Soviet cable industry claims that one ton of aluminium can substitute for four tons of copper, while the manufacturing cost of aluminium is much less than that of other non-ferrous metals", Mr. Vvedensky stated.

He pointed out that Russia was using aluminium in an ever-widening range of industries. She was contemplating a switch to the use of aluminium in the building industry. "The machine-building industry has begun to use aluminium instead of steel in the construction of trucks and passenger cars, as well as in passenger railway cars. Aluminium is also used in Soviet shipbuilding and industrial piping. Manufacturers of cables and batteries no longer use lead, but aluminium, plastics materials and nickel," Mr. Vvedensky concluded.

Tin Export Restrictions

In their November review of the tin market, **A. Strauss and Co Ltd.** state that it is now considered a possibility that export restrictions on tin may be abandoned at the next meeting of the Tin Council on December 1. Removal of restrictions at the earliest date was naturally attractive to both producers and consumers, but this created the danger that premature action may be taken before it was statistically justified.

Far more important than the increase in production would be the release for immediate sale of the large stocks Malaya, Nigeria and Belgian Congo had built up under the terms of the agreement. These countries between them were estimated to have total disposable stocks amounting to 12,000 tons.

If all that metal, plus the 5,000 tons quarterly increase in current production and 2,500 tons from the United Kingdom stockpile, were to become available to the market without restriction, there would be a substantial surplus of supplies and the whole purpose of the tin scheme would be vitiated, perhaps for a long time.

Consideration of these facts lead to the conclusion, Strauss write, that if a partial or total abandonment of export quota restrictions were agreed upon, it should be accompanied by an undertaking to retain stocks in producing countries at their present figure, or by agreement dispose of them in equal quantities spread over a specified period.

The raising of the Buffer Stock selling price by £5 per ton to £799 last week greatly intrigued the market and induced wide discussion as to its significance. It would almost seem that the Council became uneasy at the rate they had to sell from the Buffer Stock to keep the price down to £794 in recent weeks.

Future action of the Council, the report continued, depended largely on how much metal was now left in the Buffer Stock and whether it was the Council's policy to dispose of it completely. There has been an authoritative denial of a recent report that only about 3,000 tons remained. "In our view", Strauss wrote, "the real figure is probably at least twice as large, but this is admittedly a guess, which we put forward with all reserve.

The 600 Group

It is 125 years ago since George Cohen founded the firm which today is familiarly known as the 600 Group, or, in its more official form, as **George Cohen Sons and Company Limited.** Probably the founder of the firm never visualized the extent to which his activities might later be extended for he died in 1890, but prior to that Mr. George Cohen had the satisfaction not only of taking three of his sons into partnership with him, but also of seeing his original scrap metal business enlarged by the addition of shipbreaking work.

The business continued to grow and from 1900 onwards other companies began to be acquired and the engineering activities of the firm extended. In 1924 the original Cohen company was registered as a limited liability company, the existing partners in that year becoming directors and shareholders.

During the second world war the group of companies was very active in the field of metals, various factories were erected and a vast network of engineering activities were carried out in connection with the supply of war equipment. In 1947 the firm was turned into a public company but the members of the family still remained at the helm and still to-day provide most of the active directors. Although the business of this group of companies is so varied and world-wide, it still remains faithful to its foundation, and scrap metals remain one of its most important departments. The descendants of the founder must be very proud to-day of a business which is now turning over something like £30,000,000 annually and, in fact, which is still growing.

Change of Name

It has been announced by the Dow Chemical Company, of U.S.A., that its British subsidiary—Dobeckmun Britain Limited—has changed its name to **Dow Chemical Company (U.K.) Limited,** and broadened the scope of its activities.

The company will continue to handle the manufacture and sale of Lurex, a non-tarnishing metallic yarn. In addition it will take over direct sales of Dow-produced packaging films such as Trycite (Dow polystyrene film), Saran Wrap (Dow vinyl-vinylidene chloride copolymer film), and polyethylene film. It will also supervise the sales of Dow U.S. and Canadian-produced industrial chemicals, plastics and magnesium in the United Kingdom.

Arc Welding

Greater flexibility in welding capacity has occupied the attention of **Dohm Limited,** who have introduced their "Midget" and "Twin Midget" electric arc welding machines, whose small bulk and comparatively low weight makes them portable.

These machines have a maximum output of 160 amp on 50 open circuit voltage, or 120 amp on 75 open circuit voltage. They are supplied complete with accessories.

Nucleonic Counting Instruments

Their latest range of equipment, the "1800" series, has been announced by **Isotope Developments Ltd.** This is a brand new series of budget priced nucleonic counting instruments designed to give accuracy in operation, full flexibility of application and extreme simplicity of maintenance and servicing. The instruments are supplied in attractively styled cabinets with tilt-up stand so that they can be used singly or stacked one above the other. They can also be converted readily to rack mounting instruments when required. Since all connectors are mounted at the rear and the cabinet is fitted from the front, access can be obtained to the interior without disconnecting cables.

Printed circuit plug-in boards are used extensively throughout the series, and an identical power pack is fitted in all units to simplify spares requirements and servicing. Each instrument, after 100 hr. test, is despatched with a fully detailed service manual, and packaged spares kits can be provided at the same time.

Parliamentary News

By Our Lobby Correspondent

A suggestion in relation to non-ferrous mining was made by the new M.P. for Bishop Auckland, Mr. James Boyden, during the Second Reading debate on the Local Employment Bill in the Commons.

He said there were nine non-ferrous mining areas in the country where the geologists said there were substantial lead and other deposits at rather considerable depths. The exploitation of those resources was not beyond our capacity. The Mining Journal of 29th May stated that for the expenditure of about £300,000 in exploratory deep boring and other survey work, it would be possible to set flowing about £5,000,000 worth a year of lead and other products. If it was not too much for the theories of the Government, he hoped they would revise the wartime Non-Ferrous Metals Development Company, Ltd., to carry out such exploration.

Forthcoming Meetings

November 24 — Institution of Plant Engineers. South Wales Branch, South Wales Engineers' Institute, Park Place, Cardiff. "The Engineering Applications of Electro-Deposited Metals." J. W. Oswald. 7.30 p.m.

November 25—Institution of Production Engineers. Midlands Region. Walker Technical College, Oakengates, Shrewsbury. "The Fabrication of Nuclear Power Plants." S. H. Griffiths. 7.30 p.m.

November 26—Birmingham Metallurgical Society Inc. Joint Meeting with Birmingham Local Section of the Institute of Metals. College of Technology, Gosta Green, Birmingham, 4. "A Metallurgical Cocktail." Marcus A. Wheeler. 6.30 p.m.

November 27 — Institution of Plant Engineers. Birmingham Branch. Imperial Hotel, Temple Street, Birmingham. "Instrumentation in Industry with Particular Reference to Control of Temperature, Pressure Flow, Weight, etc." L. F. Cohen. 7.30 p.m.

November 27—Institute of Metal Finishing. Sheffield and North-East Branch. Grand Hotel, Sheffield. "The Accelerated Weathering of Organic Finishes." President, A. A. B. Harvey. 7 p.m.

Metal Market News

THE September figures of consumption in the United Kingdom issued by the British Bureau of Non-ferrous Metal Statistics show, as might be expected, a considerable improvement on August, which was a holiday month. Consumption of refined copper rose from 30,886 tons to 45,178 tons, and of secondary metal from 9,735 tons to 12,189 tons. Stocks, however, declined from 89,483 tons at August 31 to 77,443 tons at the end of September. In lead, usage was 30,255 tons against 23,358 tons in August, both these figures covering primary and secondary metal. Stocks at 63,121 tons were about 2,900 tons down. In zinc, the increase in consumption was very marked, for the September total of 31,270 tons compared with 21,566 tons during August. Stocks showed little change, being 637 tons up at 40,995 tons. In tin consumption rose from 1,237 tons to 2,098 tons, while stocks were 128 tons down at 10,624 tons. Although demand for physical copper was not reported as being at all brisk, business on the Metal Exchange was good, tin and lead in particular achieving unusually high turnovers. Price movements were rather erratic during the course of the week's trading and both copper and tin closed below the best levels recorded during the week. Wall Street showed a somewhat irregular tendency, while on the London Stock Exchange the second half of the week saw some hesitation in certain directions. On the whole, however, there is a good deal of optimism about the immediate future of trade and commerce in the United Kingdom.

The week began for copper with the announcement of a further decline of 1,050 tons in warehouse stocks to 6,807 tons, and on Monday the settlement price at £266 was the highest achieved this year and, indeed, since early in 1957, but a backwardation of £15 10s. 0d. put three months at £250 10s. 0d. Over the week-end it was announced that the steel strikers were returning to work for a "cooling off" period of 80 days under the ruling of the Taft-Hartley Act. But this was the top for the week in the standard copper quotation, for on the following day came news that Phelps Dodge had offered, or were going to offer, a new contract to the union, and values dropped rather sharply in consequence. On the Wednesday, the late Kerb market was upset by news that the U.S. Government might release some 75,000 tons of copper from the stockpile and although this was subsequently denied, the bearish effect on the market persisted. On Friday it was known in London that all the producers were in line at 33 cents, and it would be wrong to suppose that before the year end a further increase will not take place. Finally, after a turnover of some 11,500 tons, both cash and three months closed £1 down at £259 and £247 10s. 0d. respectively. Whether or not the backwardation will widen is a moot point on which opinion is divided. On Friday it was reported that Kennecott had temporarily withdrawn from the market. On the afternoon, Kerb cash copper was rather firmer on this news.

Stocks of tin fell by 91 tons to 7,580 tons and during the week the price of this passed the £800 mark but subsequently fell away on a statement by the Buffer Stock manager to the effect that the pool reserves were ample. Reference was also made to the impending release by the Board of Trade of 2,500 tons of tin spread over a period as to delivery. After a turnover of 2,100 tons, cash closed £3 10s. 0d. up at £797 10s. 0d. with three months 30s. down at £796. Lead was very active with a turnover of 10,725 tons and closed £2 15s. 0d. lower for November at £71 5s. 0d., and 20s. down for February at £72 5s. 0d. In zinc, sales totalled 5,050 tons, with November £3 10s. 0d. up at £97 10s. 0d., and February 25s. better at £91.

New York

Commodity Exchange copper was easy at the end of last week on speculative selling, reflecting the decline on the London Metal Exchange and rumours of a possible settlement developing in the Phelps Dodge strike which might be a break in the industry-wide copper strike. Copper was firm but quiet, and consumers were not interested in paying the prevailing dealer offering prices. Kennecott reported it had no more copper to deliver and hence was withdrawn as a seller. This made the producer price a flat 33 cents. Dealers want around 40 cents for prompt copper.

Tin prices were softer, mostly nearbys, and only negligible buying interest was reported. Lead was more active. Buying interest was noted in zinc. Steel companies were stepping up requests for deliveries of previously ordered prime western zinc but were slow in giving new buying orders. In the cloing stages, tin was quiet and about steady. Dealers offered nearby copper at 40-40½ cents and December delivery around 40 cents. The market was quiet.

Mines in the United States produced 20,300 tons of recoverable lead in September, 1959, according to the Bureau of Mines, United States Department of the Interior. The September quantity was 6 per cent less than that of August and approximately 850 tons less than the average monthly mine output during the first eight months of the year. The price of common grade lead remained unchanged at 13 cents a pound, New York market, throughout September—a price established on August 24 when quotations were raised 1 cent a pound.

Birmingham

Speaking at a special conference of 400 leaders of Midland industry at Birmingham last week to discuss the European Free Trade Area, Mr. R. Maudling, the new President of the Board of Trade, urged medium- and small-sized firms over the whole range of manufacturing industry to make special efforts to increase their export earnings. While there had been remarkable and dramatic expansions in the motor industry and big achievements in the aircraft industry, it was unwise and dangerous to place too great a reliance in exports on only one or two sectors.

The industrial position in the Midlands presents a prosperous picture, with unemployment at a low level, and the volume of orders expanding. Supplies of raw material are obtainable within reasonable limits, but the building industry is still experiencing a shortage of bricks which is delaying some building contracts.

With the pressure for supplies of pig iron increasing there is a tendency for deliveries to be extended. These conditions obtain in the case of steel sheets and some other grades extensively used by the light engineering industries. Orders for re-rolled steel enable mills to operate at full capacity. New orders have been placed for railway rolling stock. Makers of heavy electrical equipment are well employed. Foundries making light castings are busy.

Chile

Anaconda's new El Salvador copper mine, in Atacama Province, was officially inaugurated last Friday at a ceremony attended by Government officials, diplomats and high officials of the Anaconda Company. Some 25,000 tons of ore will be treated daily at the mine and annual production is put at 100,000 tons of blister copper which will be shipped to the United States for refining. The El Salvador copper ore deposit is estimated at 380,000,000 tons with an average grade of 1·6 per cent.

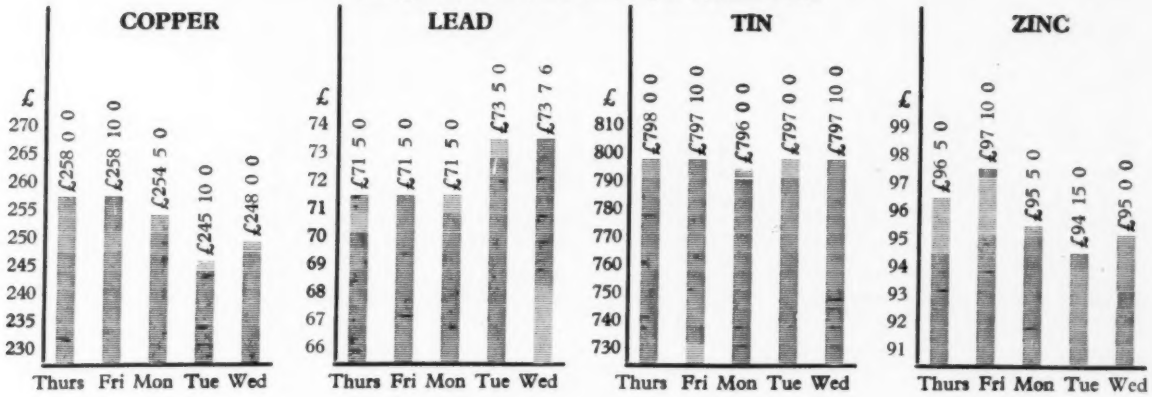
Eire

The Eire Ministry for Industry and Commerce has announced that he is prepared to consider applications for financial grants to provide technical assistance for private mineral exploration. The conditions for the grants are that the project must be approved by the Minister. The grant will be up to one-half of the cost and total expenditure must not be less than £1,000. Grants will not be made for development machinery.

Non-Ferrous Metal Prices

London Metal Exchange

Thursday 12 November to Wednesday 18 November 1959



Primary Metals

All prices quoted are those available at 2 p.m. 18/11/59

		£	s.	d.
Aluminium Ingots	ton	180	0	0
Antimony 99·6%	„	197	0	0
Antimony Metal 99%	„	190	0	0
Antimony Oxide	„	180	0	0
Antimony Sulphide Lump	„	190	0	0
Antimony Sulphide Black Powder	„	205	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		9	6
Calcium	„		2	0
Cerium 99%	„		16	0
Chromium	„		6	11
Cobalt	„		14	0
Columbite	per unit		—	
Copper H.C. Electro	ton	248	0	0
Fire Refined 99·70%	„	247	0	0
Fire Refined 99·50%	„	246	0	0

		£	s.	d.
Copper Sulphate	ton	80	0	0
Germanium	grm.		—	
Gold	oz.	12	10	3
Indium	„		10	0
Iridium	„	24	0	0
Lanthanum	grm.		15	0
Lead English	ton	73	7	6
Magnesium Ingots	lb.		2	0
Notched Bar	„		2	9½
Powder Grade 4	„		6	1
Alloy Ingot, A8 or AZ91	„		2	4
Manganese Metal	ton	245	0	0
Mercury	flask	72	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.		nom.	
Osmiridium	„		nom.	

		£	s.	d.
Palladium	oz.	8	0	0
Platinum	„	28	10	0
Rhodium	„	41	0	0
Ruthenium	„	18	0	0
Selenium	lb.		nom.	
Silicon 98%	ton		nom.	
Silver Spot Bars	oz.		6	8½
Tellurium	lb.		18	0
Tin	ton	797	10	0
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	92	8	9
Dust 95/97%	„	126	0	0
Dust 98/99%	„	132	0	0
Granulated 99+%	„	117	8	9
Granulated 99·99+%	„	134	17	6

**Duty and Carriage to customers' works for buyers' account.*

Foreign Quotations

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg ≏£/ton		**Canada** c/lb ≏£/ton		**France** fr/kg ≏£/ton		**Italy** lire/kg ≏£/ton		**Switzerland** fr/kg ≏£/ton		**United States** c/lb ≏£/ton	
Aluminium			22.50	185 17 6	224	168 0	375	221 5	2.50	212 10	26.80	214 10
Antimony 99.0					230	171 10	450	265 10			29.00	232 0
Cadmium					1,300	975 0					130.00	1,040 0
Copper												
Crude							510	301 0				
Wire bars 99.9												
Electrolytic	35.00	257 12 6	31.00	256 0 0	356	267 0			3.00	255 0	33.00	264 0
Lead			10.75	88 12 6	103	77 5	167	98 10	.88	74 17 6	13.00	104 0
Magnesium												
Nickel			70.00	578 5	900	675 0	1,200	708 0	7.50	637 10	74.00	592 0
Tin	110.75	817 2 6			1,120	840 0	1,510	891 0	9.75	828 17 6	101.37	810 17 6
Zinc												
Prime western			12.75	105 7 6								
High grade 99.95			13.35	110 5 0								
High grade 99.99			13.75	113 12 0								
Thermic					132.00	99 0 0						
Electrolytic					140.00	105 0 0	209	123 7 6	1.20	102 0	14.00	112 0

Non-Ferrous Metal Prices (continued)

Ingot Metals

All prices quoted are those available at 2 p.m. 18/11/59

	£	s.	d.
Aluminium Alloy (Virgin)			
B.S. 1490 L.M.5 .... ton	210	0	0
B.S. 1490 L.M.6 .... „	202	0	0
B.S. 1490 L.M.7 .... „	216	0	0
B.S. 1490 L.M.8 .... „	203	0	0
B.S. 1490 L.M.9 .... „	203	0	0
B.S. 1490 L.M.10.... „	221	0	0
B.S. 1490 L.M.11.... „	215	0	0
B.S. 1490 L.M.12.... „	223	0	0
B.S. 1490 L.M.13.... „	216	0	0
B.S. 1490 L.M.14.... „	224	0	0
B.S. 1490 L.M.15.... „	210	0	0
B.S. 1490 L.M.16.... „	206	0	0
B.S. 1490 L.M.18.... „	203	0	0
B.S. 1490 L.M.22.... „	210	0	0
Aluminium Alloys (Secondary)			
B.S. 1490 L.M.1 .... ton	159	0	0
B.S. 1490 L.M.2 .... „	169	0	0
B.S. 1490 L.M.4 .... „	184	0	0
B.S. 1490 L.M.6 .... „	185	0	0
***Aluminium Bronze**			
BSS 1400 AB.1..... ton	248	0	0
BSS 1400 AB.2..... „	258	0	0
***Brass**			
BSS 1400-B3 65/35 .. ton	162	0	0
BSS 249..... „	—		
BSS 1400-B6 85/15 .. „	209	0	0
***Gunmetal**			
R.C.H. 3/4% ton .... „	—		
(85/5/5/5) LG2 ..... „	203	0	0
(86/7/5/2) LG3 ..... „	213	0	0
(88/10/2/1) ..... „	256	0	0
(88/10/2/½) ..... „	268	0	0
***Manganese Bronze**			
BSS 1400 HTB1 .... „	188	0	0
BSS 1400 HTB2 .... „	210	0	0
BSS 1400 HTB3 .... „	227	0	0
Nickel Silver			
Casting Quality 12% „	242	0	0
„ „ 16% „	247	0	0
„ „ 18% „	267	0	0
***Phosphor Bronze**			
B.S. 1400 P.B.1. (A.I.D. released)..... „	301	0	0
B.S. 1400 L.P.B.1.... „	222	0	0
Phosphor Copper			
10% ..... ton	264	0	0
15% ..... „	266	0	0
Phosphor Tin			
5% ..... „	—		
Silicon Bronze			
BSS 1400-SB1 ..... „	263	0	0
Solder, soft, BSS 219			
Grade C Tinmans.... „	371	10	0
Grade D Plumbers .. „	299	0	0
Grade M ..... „	407	15	0
Solder, Brazing, BSS 1845			
Type 8 (Granulated) lb.	—		
Type 9 „ „	—		
Zinc Alloys			
B.S.S.1004 Alloy A .. ton	128	2	6
B.S.S.1004 Alloy B .. „	132	2	6
Sodium-Zinc ..... lb.		2	8½

Average prices for the last week-end.

Semi-Fabricated Products

Prices vary according to dimensions and quantities. The following are the basis prices for certain specific products

Aluminium			
Sheet 10 S.W.G. lb.	2	8½	
Sheet 18 S.W.G. „	2	10½	
Sheet 24 S.W.G. „	3	1½	
Strip 10 S.W.G. „	2	8½	
Strip 18 S.W.G. „	2	9½	
Strip 24 S.W.G. „	2	11	
Circles 22 S.W.G. „	3	2½	
Circles 18 S.W.G. „	3	1½	
Circles 12 S.W.G. „	3	0½	
Plate as rolled ..... „	2	8	
Sections ..... „	3	2	
Wire 10 S.W.G. .... „	2	11½	
Tubes 1 in. o.d. 16 S.W.G. ..... „	4	1	
Aluminium Alloys			
BS1470. HS10W.			
Sheet 10 S.W.G. „	3	1	
Sheet 18 S.W.G. „	3	3½	
Sheet 24 S.W.G. „	3	11	
Strip 10 S.W.G. „	3	1	
Strip 18 S.W.G. „	3	2½	
Strip 24 S.W.G. „	3	10½	
BS1477. HP30M.			
Plate as rolled .... „	2	11	
BS1470. HC15WP.			
Sheet 10 S.W.G. „	3	9½	
Sheet 18 S.W.G. „	4	2	
Sheet 24 S.W.G. „	5	0½	
Strip 10 S.W.G. „	3	10½	
Strip 18 S.W.G. „	4	2	
Strip 24 S.W.G. „	4	9½	
BS1477. HPC15WP.			
Plate heat treated.. „	6	3½	
BS1475. HG10W.			
Wire 10 S.W.G. „	3	10½	
BS1471. HT10WP.			
Tubes 1 in. o.d. 16 S.W.G. ..... „	5	0½	
BS1476. HE10WP.			
Sections ..... „	3	1½	
Brass			
Tubes ..... „	2	0	
Brazed Tubes..... „	3	1⅞	
Drawn Strip Sections „	3	2½	
Sheet ..... ton	215	5	0
Strip ..... „	215	5	0
Extruded Bar..... lb.	2	2⅞	
Extruded Bar (Pure Metal Basis) ..... „	—		
Brass			
Condenser Plate (Yellow Metal) ..... ton	213	0	0
Condenser Plate (Naval Brass) ..... „	225	0	0
Wire ..... lb.	2	9⅝	
Beryllium Copper			
Strip ..... „	1	4	11
Rod ..... „	1	1	6
Wire ..... „	1	4	9
Copper			
Tubes ..... lb.	2	4¾	
Sheet ..... ton	279	0	0
Strip ..... „	279	0	0
Plain Plates ..... „	—		
Locomotive Rods .... „	—		
H.C. Wire ..... „	309	15	0
Cupro Nickel			
Tubes 70/30 ..... lb.	3	8⅝	
Lead			
Pipes (London) .... ton	114	15	0
Sheet (London) .... „	112	10	0
Tellurium Lead .... „	£6 extra		
Nickel Silver			
Sheet and Strip 7% .. lb.	3	10¾	
Wire 10% ..... „	4	5½	
Phosphor Bronze			
Wire ..... „	4	2½	
Titanium (1,000 lb. lots)			
Billet 4½″ to 18″ dia... lb.	54/-	55/-	
Rod ½″ to 4″ dia. .... „	95/-	62/-	
Wire ·036″-·232″ dia. „	167/-	110/-	
Strip ·003″ to ·048″ .. „	200/-	75/-	
Sheet 8′ × 2′. 20 gauge „	85/-		
Tube, representative average gauge .... „	300/-		
Extrusions ..... „	105/-		
Zinc			
Sheet ..... ton	130	5	0
Strip ..... „	nom.		

Domestic and Foreign

Merchants' average buying prices delivered, per ton, 17/11/59.

	£
Aluminium	
New Cuttings	151
Old Rolled	134
Segregated Turnings	106
Brass	
Cuttings	176
Rod Ends	162
Heavy Yellow	129
Light	123
Rolled	166
Collected Scrap	126
Turnings	156
Copper	
Wire	233
Firebox, cut up	216
Heavy	214
Light	216
Cuttings	233
Turnings	207
Braziery	170
Gunmetal	
Gear Wheels	180
Admiralty.....	180
Commercial	174
Turnings	169
Lead	
Scrap	63
Nickel	
Cuttings	—
Anodes	550
Phosphor Bronze	
Scrap	174
Turnings	169
Zinc	
Remelted	86
Cuttings	73
Old Zinc	50

Metal Statistics

Detailed figures of the consumption and output of non-ferrous metals for the month of Sept., 1959, have been issued by the British Bureau of Non-Ferrous Metal Statistics, as follows in long tons:—

COPPER	Gross Weight	Copper Content
Wire	23,808	23,335
Rods, bars and sections	14,289	9,334
Sheet, strips and plate	14,498	11,394
Tubes	7,740	7,180
Castings and miscellaneous	7,131	—
Sulphate	1,159	—
	68,625	57,367
Of which:		
Consumption of Virgin Copper		45,178
Consumption of Copper and Alloy Scrap (Copper Content)		12,189

LEAD	
Cables	8,569
Batteries	2,684
Battery Oxides	2,275
Tetra Ethyl Lead	1,649
Other Oxides and Compounds	2,463
White Lead	780
Shot	449
Sheet and Pipe	6,280
Foil and Collapsible Tubes	345
Other Rolled and Extruded	591
Solder	1,293
Alloys	1,639
Miscellaneous Uses	1,238
Total	30,255

TIN	
Tinplate	1,049
Tinning:	
Copper Wire	48
Steel Wire	10
All other	72
Solder	220
Alloys	508
Foil and Collapsible Tubes, etc.	42
Tin Compounds, Salts, and Miscellaneous Uses	124
Total Consumption	2,073

ZINC	
Galvanizing	8,952
Brass	9,658
Rolled Zinc	2,059
Zinc Oxide	2,524
Zinc Die-casting alloy	5,922
Zinc Dust	1,220
Miscellaneous Uses	935
Total, All Trades	31,270
Of which:	
High purity 99·99 per cent	6,324
Electrolytic and high grade 99·95 per cent	5,741
Prime Western, G.O.B. and debased	11,524
Remelted	517
Scrap Brass and other Cu alloys	3,833
Scrap Zinc, alloys and residues	3,107

ANTIMONY	
Batteries	105
Other Antimonial Lead	47
Bearings	33
Oxides—for White Pigments	111
Oxides—other	90
Miscellaneous Uses	17
Sulphides	6
Total Consumption	409
Antimony in Scrap	
For Antimonial Lead	367
For Other Uses	40
Total Consumption	407

CADMIUM	
Plating Anodes	70·70
Plating Salts	8·95
Alloys: Cadmium Copper	2·55
Alloys: Other	5·15
Batteries: Alkaline	7·55
Batteries: Dry	0·45
Solder	7·70
Colours	28·10
Miscellaneous Uses	1·50
Total Consumption	132·65

Scrap Metal Prices

The figures in brackets give the English equivalents in £1 per ton:—

France (francs per kilo):

Electrolytic copper scrap	(£217.2.6)	280
Heavy copper	(£217.2.6)	280
No. 1 copper wire	(£202.10.0)	260
Brass rod ends	(£146.2.6)	190
Zinc castings	(£57.12.6)	85
Lead	(£69.0.0)	92
Aluminium	(£135.0.0)	180

Italy (lire per kilo):

Aluminium soft sheet clippings (new)	(£200.15.0)	340
Lead, soft, first quality	(£81.10.0)	138
Lead, battery plates	(£46.0.0)	78
Copper, first grade	(£238.17.6)	405
Bronze, commercial gunmetal	(£188.17.6)	320
Brass, heavy	(£162.5.0)	275
Brass, light	(£147.12.6)	250
Brass, bar turnings	(£151.10.0)	260
Old zinc	(£56.0.0)	95

Japan (Yen per metric ton):

Electrolytic copper	(£—)	335,000
Copper wire No. 1	(£—)	305,000
Copper wire No. 2	(£—)	255,000
Heavy copper	(£—)	300,000
Light copper	(£—)	250,000
Brass, new cuttings	(£—)	220,000
Red brass scrap	(£—)	223,000

West Germany (D-marks per 100 kilos):

Used copper wire	(£223.17.6)	256
Heavy copper	(£222.12.6)	254
Light copper	(£189.5.0)	216
Heavy brass	(£132.5.0)	151
Light brass	(£98.0.0)	112
Soft lead scrap	(£59.17.6)	68
Zinc scrap	(£48.2.6)	55
Used aluminium unsorted	(£105.2.6)	120

Financial News

Wallis Tin Stamping

Profit year ended June 30, 1959, £49,813 (£53,569), subject to tax £16,697 (£29,009) less tax adjustment £2,311 (£893). Dividend 25 per cent (same). Fixed assets £479,944 (£453,689) and net current assets £13,528 (£30,274).

J. Brockhouse and Co.

Group trading profits for the year to September 30 last are shown at £801,358, against £781,886 for the previous year. New balance after taxation, etc., shown at £472,329 (£341,557). Final dividend of 7 per cent making 10 per cent for the year.

Brett's Stamping

Net profit year to July 31, 1959, is £17,072 (£23,434) and same again dividend 15 per cent on Ordinary. Fixed assets £153,266 (£127,310), net current assets £276,968 (£320,562). Commitments £3,500.

Hughes-Johnson Stampings

Group net profit year to August 3, 1959, is £17,257 (£63,222) and distribution 20 (25) per cent. Fixed assets £206,529 (£205,157), net current assets £594,228 (£647,873).

New Companies

The particulars of companies recently registered are quoted from the daily register compiled by Jordan and Sons Limited, Company Registration Agents, Chancery Lane, W.C.2.

East Anglian Metal Merchants Limited (639008), 66 Cottesmore Gardens, Leigh-on-Sea. Registered October 7, 1959. Nominal capital, £1,000 in £1 shares. Directors: Derek L. Kemp and Joan M. Kemp (both permanent) and Charles R. Turner.

J. R. Tools and Diecastings Limited (639287), 8 Station Close, Potters Bar, Middx. Registered October 9, 1959. Nominal capital, £1,000 in £1 shares. Directors: Jeffrey Russen, Wm. A. Lowe and Chas A. Kempster.

Wire Weld (London) Limited (639298), 198-204 Lewisham High Street, S.E.13. Registered October 9, 1959. To carry on business of iron and brass founders, metallurgists, etc. Nominal capital, £1,000 in £1 shares. Directors: Derek J. Sales, Denis North and Kenneth J. Castle.

Electroplate (Cardiff) Limited (639389), 53 Cathedral Road, Cardiff. Registered October 13, 1959. Nominal capital, £2,500 in £1 shares. Directors: Thomas W. Castle and Roger P. F. Llewellyn.

Castalite Limited (639628), Bayton Road, Exhall, near Coventry. Registered October 15, 1959. Nominal capital, £1,000 in £1 shares. To carry on business of ferrous and non-ferrous founders, plastics moulders, etc. Director: Sidney T. Jones and Eddie A. J. Large.

Darwen Processors Limited (639891), Sough Works, Sough Road, Darwen, Lancs. Registered October 19, 1959. To carry on business of processors of ferrous and non-ferrous metals, ores and alloys, etc. Nominal capital, £100 in £1 shares (97 "A" Ord. and 3 "B" Ord.). Directors: George Rollinson, George D. Rollinson, John M. Rollinson and Peter F. Rollinson.

THE STOCK EXCHANGE

Slight Set-back In Steel And Engineering Shares

ISSUED CAPITAL •	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 16 NOVEMBER +RISE — FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1959 HIGH	1959 LOW	1958 HIGH	1958 LOW
£	£			Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	32/– —3d.	9	9	5 12 6	33/–	23/3	24/9	17/6
400,000	2/–	Anti-Attrition Metal	1/3	4	8½	6 15 0	1/6	1/3	1/9	1/3
41,303,829	Stk. (£1)	Associated Electrical Industries ...	64/– +6d.	15	15	4 13 9	67/–	54/–	58/9	46/6
1,613,280	1	Birfield	68/6xd	15	15	4 7 6	75/–	46/9	62/4½	46/3
3,196,667	1	Birmid Industries	103/–xd +6/3	20	17½	3 17 9	108/9	72/–	77/6	55/3
5,630,344	Stk. (£1)	Birmingham Small Arms	60/6xd +1/6	12½	11	4 2 6	63/3	36/1½	39/–	23/9
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	15/9	5	5	6 7 0	16/3	15/–	16/1½	14/7½
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	20/– +1/4½	6	6	6 0 0	20/–	17/9	17/4½	16/6
500,000	1	Bolton (Thos.) & Sons	45/–	10	10	4 9 0	45/–	27/6	28/9	24/–
300,000	1	Ditto Pref. 5%	15/–	5	5	6 13 3	15/6	14/–	16/–	15/–
160,000	1	Booth (James) & Co. Cum. Pref. 7%	20/6	7	7	6 16 6	20/6	20/–	20/4½	19/–
1,500,000	Stk. (£1)	British Aluminium Co. Pref. 6% ...	19/9	6	6	6 1 6	20/7½	18/9	20/–	18/4½
17,247,070	Stk. (£1)	British Insulated Callender's Cables	55/9 +3/3	12½	12½	4 9 9	61/–	46/3	52/6	38/9
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord. ...	77/– +3d.	10	10	2 12 0	79/6	49/3	52/–	28/3
1,200,000	Stk. (5/–)	Canning (W.) & Co.	15/10½ —1½d.	25+ *2½C‡	25	3 18 9	16/–	12/3	25/3	19/3
60,484	1/–	Carr (Chas.)	2/–	12½	25	6 5 0	2/10½	1/3	2/3	1/4½
555,000	1	Clifford (Chas.) Ltd.	26/6	10H	10	7 11 0	27/–	22/6	22/–	16/–
45,000	1	Ditto Cum. Pref. 6%	16/9	6	6	7 3 3	17/–	15/3	16/–	15/–
250,000	2/–	Coley Metals	3/6	15	20	8 11 6	4/–	2/10½	4/6	2/6
10,185,696	1	Cons. Zinc Corp.†	74/–	15	18¾	4 1 0	75/9	59/–	65/3	41/–
1,509,528	1	Davy & United	107/– +3/6	30‡	20	2 16 0	107/–	43/1½	87/–	45/9
6,840,000	5/–	Delta Metal	22/9 +1/3	31‡	30	3 8 0	23/6	12/–	25/–	17/7½
5 296,550	Stk. (£1)	Enfield Rolling Mills Ltd.	58/3 —3d.	15	12½	5 3 0	60/–	36/7½	38/–	22/9
750,000	1	Evered & Co.	36/9	10§	15D	5 8 9	36/9	30/–	30/–	26/–
18,000,000	Stk. (£1)	General Electric Co.	43/6 +9d.	10	10P	4 12 0	48/9	30/–	40/6	29/6
1,500,000	Stk. (10/–)	General Refractories Ltd.	45/9 +6d.	20	20	4 7 6	46/3	31/9	39/3	27/3
401,240	1	Gibbons (Dudley) Ltd.	67/–	16½	15	4 18 6	67/–	63/–	67/6	61/–
750,000	5/–	Glacier Metal Co. Ltd.	10/3	11½	11½	5 12 3	10/3	6/7½	8/3	5/–
1,750,000	5/	Glynwed Tubes	26/– +3d.	20¶	20	3 17 0	26/3	16/4½	18/1½	12/10½
5,421,049	10/–	Goodlass Wall & Lead Industries ...	48/6 +1/6	13‖	16D	2 15 3	49/6	28/7½	30/9	17/3
342,195	1	Greenwood & Batley	110/–	30	20	5 9 0	110/–	75/–	57/9	45/–
396,000	5/–	Harrison (B'ham) Ord.	26/3 +9d.	*17½	*15	3 6 9	26/3	14/11½	15/9	11/6
150,000	1	Ditto Cum. Pref. 7%	19/6	7	7	7 3 6	19/6	19/3	19/9	18/4½
1,075,167	5/–	Heenan Group	14/7½xd	15	10	5 2 6	15/–	7/6	9/7½	6/9
246,209,422	Stk. (£1)	Imperial Chemical Industries ...	55/9 +1/9	12DZ	10	2 17 6	58/9	33/9	38/–	24/3
34,736,773	Stk. (£1)	Ditto Cum. Pref. 5%	18/9	5	5	5 6 9	18/9	16/–	17/1½	16/–
14,584,025	**	International Nickel	181½ +2½	$3	$2.60	2 18 6	187¾	154½	169	132¾
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	16/3	5	5	6 3 0	16/3	15/4½	16/9	15/–
6,000,000	1	Ditto Ord.	48/9 +1/–	12D	10	3 5 9	49/–	29/7½	47/–	36/6
600,000	10/–	Keith, Blackman	31/3	17½E	15	4 7 0	31/3	25/–	28/9	15/–
320,000	4/–	London Aluminium	7/3	10	10	5 10 3	8/3	5/3	6/–	3/–
765,012	1	McKechnie Brothers Ord.	58/6xd —6d.	15F	15	5 2 6	63/9	41/–	45/–	32/–
1,530,024	1	Ditto A Ord.	58/–xd +3d.	15F	15	5 3 6	62/–	38/9	45/–	30/–
1,108,268	5/–	Manganese Bronze & Brass	18/– —6d.	20§	20	5 14 6	18/6	13/9	14/1½	8/9
50,628	6/–	Ditto (7½% N.C. Pref.)	6/–	7½	7½	7 10 0	—	—	6/3	5/6
13,098,855	Stk. (£1)	Metal Box	79/– +3/9	11	11	2 15 9	80/–	44/7½	73/3	40/6
415,760	Stk. (2/–)	Metal Traders	10/– —1/–	50	50	10 0 0	12/3	8/4½	9/–	6/3
160,000	1	Mint (The) Birmingham	31/6	10	10	6 7 0	31/6	22/–	22/9	19/–
80,000	5	Ditto Pref. 6%	80/–	6	6	7 10 0	75/6	69/–	83/6	69/–
5,187,938	Stk. (£1)	Morgan Crucible A	51/6xcap +2/–	10φ	10	2 15 6	51/6	30/7½	45/–	34/–
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	18/6	5½	5½	5 19 0	18/6	17/6	18/–	17/–
2,200,000	Stk. (£1)	Murex	63/3 +6/3	15	17½	4 14 0	63/3	41/–	58/9	46/–
468,000	5/–	Ratcliffs (Great Bridge)	13/6 +6d.	10R	10	2 15 6	13/6	9/6	11/1½	6/10½
234,960	10/–	Sanderson Bros. & Newbould ...	55/–xd +4½d.	25	20	4 11 0	55/–	27/9	27/3	24/6
1,365,000	Stk. (5/–)	Serck	30/3 +9d.	17½GB	15	2 17 9	30/9	18/–	18/7½	11/–
6,698,586	Stk. (£1)	Stone-Platt Industries	61/6xd	15	15	4 17 6	63/–	42/6	45/6	22/6
2,928,963	Stk. (£1)	Ditto 5½% Cum. Pref.	17/9 —6d.	5½	5½	6 4 0	18/3	15/10½	16/3	12/7½
18,255,218	Stk. (£1)	Tube Investments Ord.	117/6xd +1/4½	20	17½	3 8 0	121/3	72/–	86/–	48/4½
41,000,000	Stk. (£1)	Vickers	30/– —3d.	10	10	6 13 3	37/–	27/4½	36/3	28/9
750,000	Stk. (£1)	Ditto Pref. 5%	15/–	5	5	6 13 9	15/0¾	14/3	15/9	14/3
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	23/–	*5	*5	6 9 6A	23/–	20/6	23/–	21/3
2,200,000	1	Ward (Thos. W.), Ord.	143/9xd +2/3	25	20	3 9 6	147/6	83/–	87/3	70/9
2,666,034	Stk. (£1)	Westinghouse Brake	52/9	10	10	3 16 0	53/9	39/9	46/6	32/6
225,000	2/–	Wolverhampton Die-Casting ...	12/3 +6d.	30	30	4 18 0	13/3	8/8½	10/1½	7/–
591,000	5/–	Wolverhampton Metal	31/–	27½	27½	4 8 9	32/6	21/6	22/9	14/9
78,465	2/6	Wright, Bindley & Gell	7/3 +3d.	20	20	6 18 0	7/6	4/11½	5/4½	2/9
124,140	1	Ditto Cum. Pref. 6%	13/9	6	6	8 14 9	13/9	12/10½	13/–	11/3
150,000	1/–	Zinc Alloy Rust Proof	3/4½ —1½d.	27	40D	8 0 0	3/9¾	2/9	3/1½	2/7½

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting. **Shares of no Par Value. ‡ and 100% capitalized issue. •The figures given relate to the issue quoted in the third column. A Calculated on £7 8 9 gross. Y Calculated on 11½% dividend. ‖Adjusted to allow for capitalization issue. D And 50% capitalized issue. C Paid out of Capital Profits. E and 50% capitalized issue in 7% 2nd Pref. Shares. § And Special distribution of 2½% free of tax. R And 33⅓% capitalized issue in 8% Maximum Ordinary 5/– Stock Units. ¶ Interim since increased from 10% to 12%. φ And 40% capitalized issue. Z Interim since increased. B And proposed 50% capitalized issue. G And 1¾d. special distribution. F And special 5% tax free dividend. H And Capital Dividend of 7½%.

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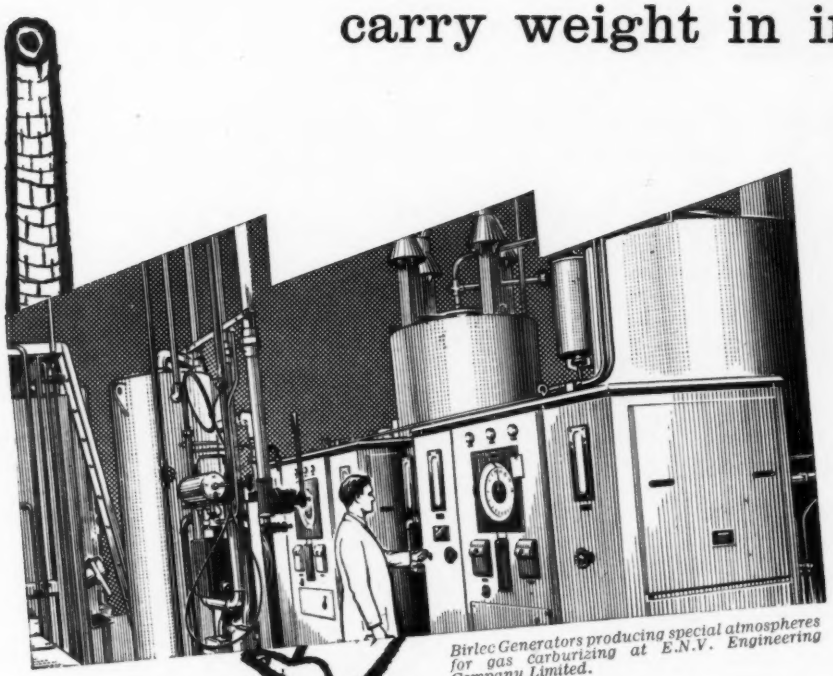

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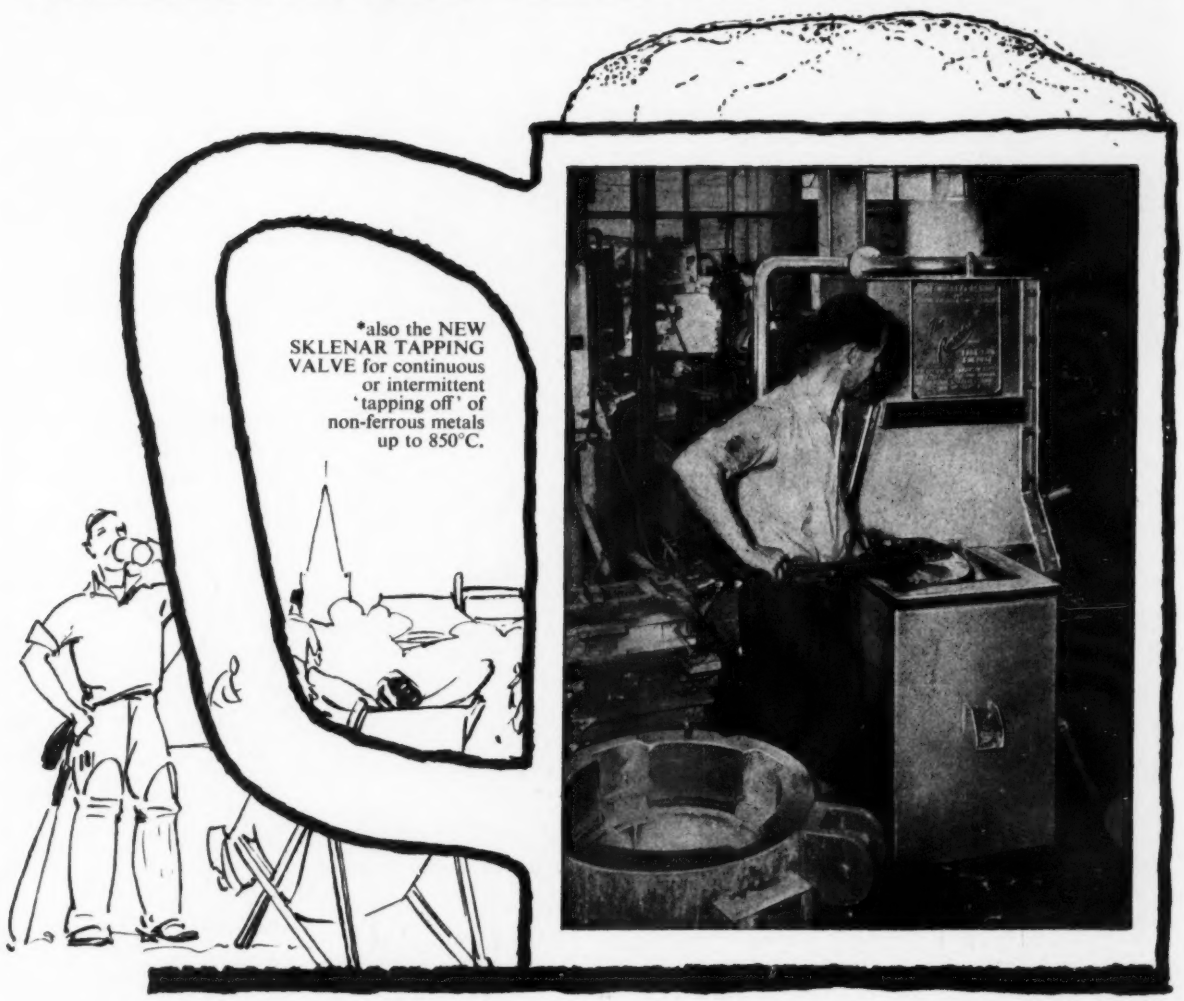

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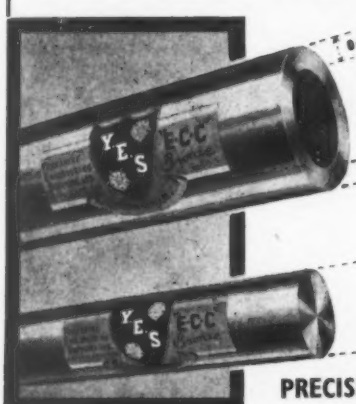

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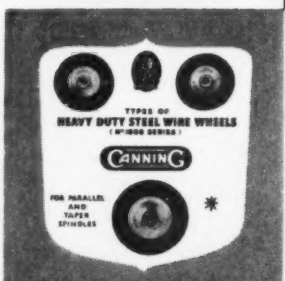

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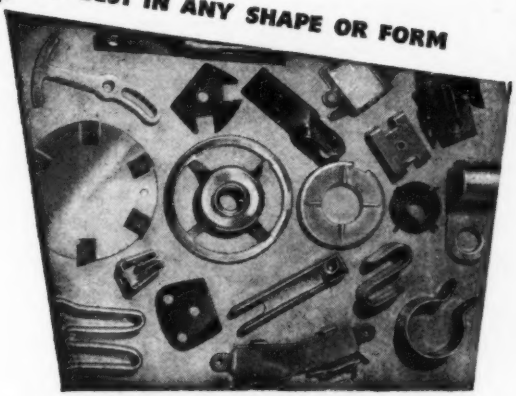

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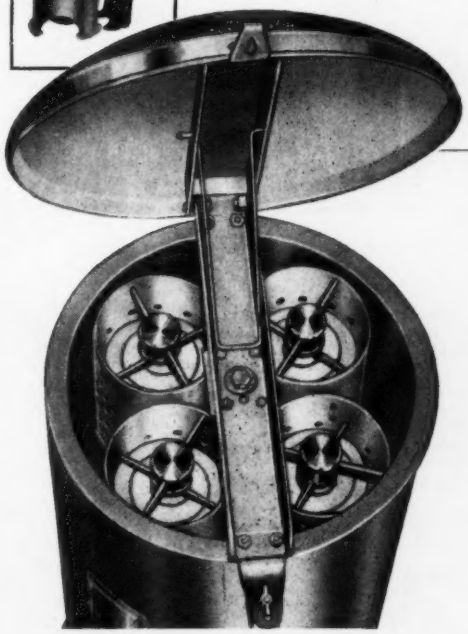

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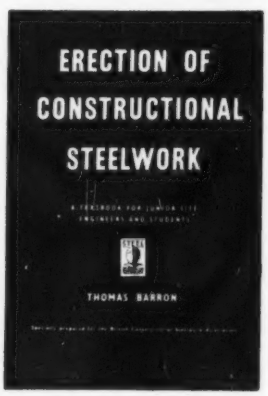

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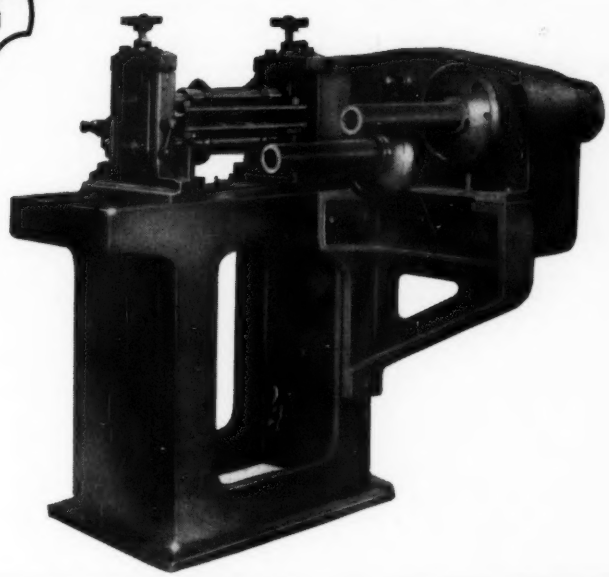

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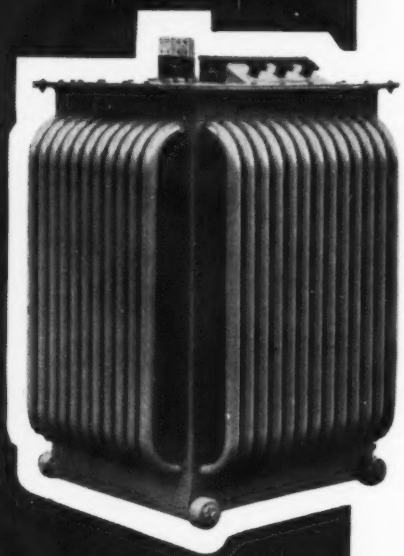

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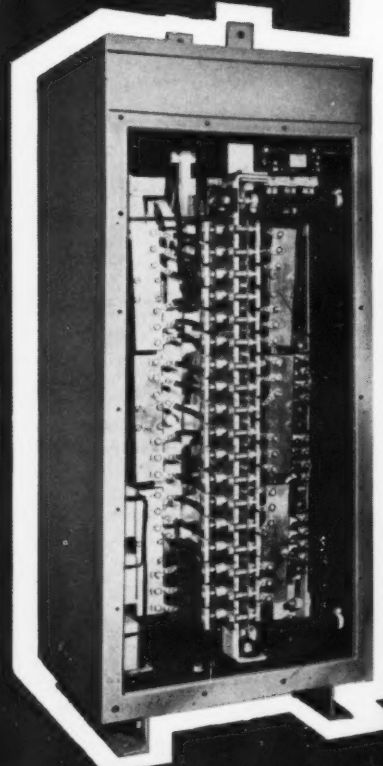

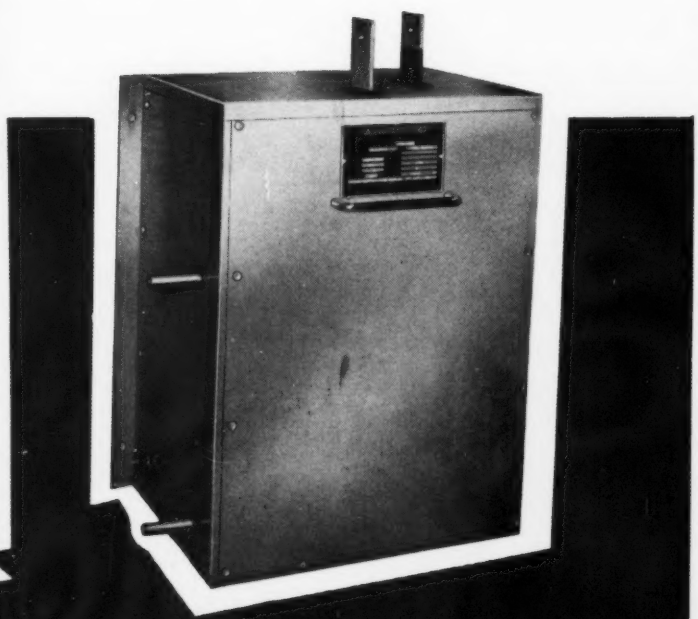

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